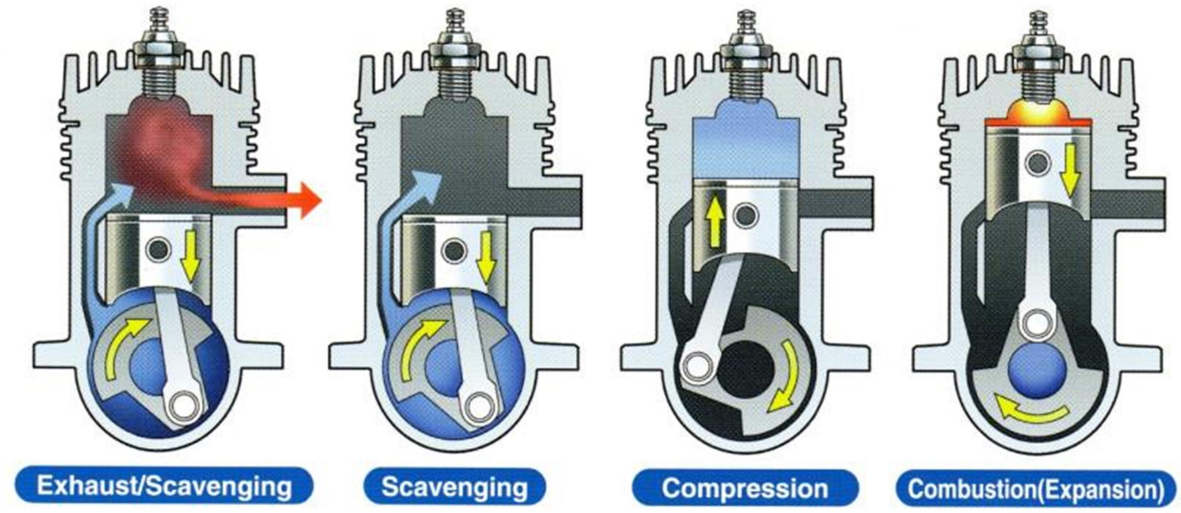
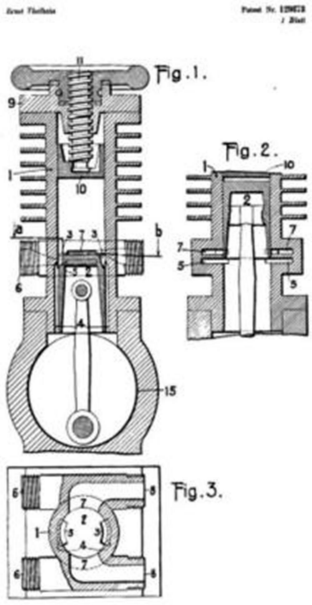
Danish Model Engines.

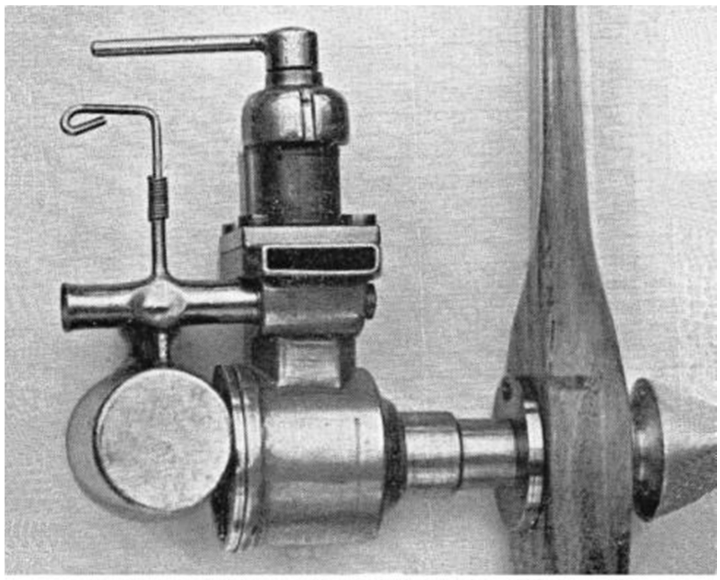
Collection by Ove Svend Andersen (OS)



Most model engines are two-stroke. This is the most “simple” design for an engine with very few moving parts. The following descriptions only concerns two-stroke engines.



Ernst Thalheim’s original 1928 patent drawing



2.5 cc ETHA 1 diesel (Laidlaw-Dickson)

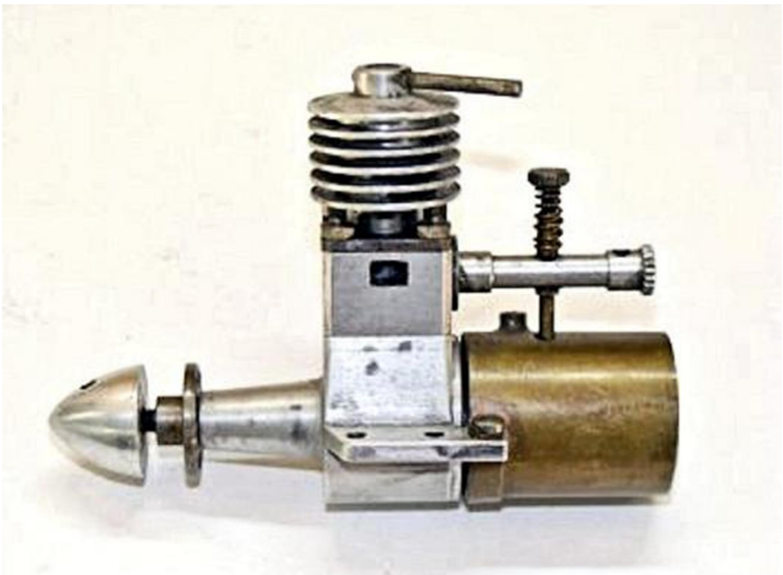
The concept of the model compression ignition engine goes back way further than many of today’s model engine enthusiasts may realize. In the past it has often been stated that the Swiss Dyno 2 cc model of 1941 was the “first” model diesel. While that view may have some

validity in terms of widespread acceptance and design influence, the concept actually dates back to December 17th, 1928, when the first patent for a variable compression two-stroke "diesel" engine was granted to one Ernst Thalheim, a resident of Switzerland. Some ten years later, Thalheim went into production with a series of model engines which were marketed from 1938 onwards under the ETHA label.

During the interim, the idea of utilizing compression ignition specifically for model engines had surfaced in Germany. In 1937 the talented model engineer Gustav Eisfeld of Gera, Germany began his own experiments with model compression ignition engines. However, Eisfeld chose a different and far more challenging development path by working on “true” diesels equipped with fixed compression, miniature injectors and high-pressure fuel pumps. This approach may have been directed at getting around Thalheim's patent.

Be that as it may, by the end of 1937 Eisfeld had built a successful prototype having a displacement of 15 cc (0.915 cuin.). This engine ran on a fixed 22:1 compression ratio and was equipped with a high-pressure injection pump and a needle injector. When properly adjusted, it apparently ran very well on regular full-sized diesel fuel.

A promising start, but further development of this remarkable engine was halted in view of the far greater ease of manufacture and superior dependability of the conventional spark ignition engines of that time. Even so, following the onset of war in 1939 and working in collaboration with A. Thusius, Eisfeld did resume his model diesel experiments, citing his reasons for doing so as the unreliability of the miniature accumulators, then available as well as the problematic availability of dry batteries under wartime conditions. Eventually in 1942 he produced an amazing and successful 3.7 cc (0.225 cuin.) injector-equipped true diesel prototype suitable for model aircraft. Reportedly this unit weighed no more than a comparable spark ignition model with its ignition support equipment. Its compression ratio was a daunting 23:1 - starting must have been fun!



1942 Eisfeld 0.5 cc diesel

Since Ernst Thalheim's 1928 patent was set to expire in December 1942 in any case, Eisfeld concentrated thereafter on the development and production of his excellent conventional “diesel” models which were designed in collaboration with A. Thusius. The Eisfeld model diesels were produced in a range of displacements from 0.5 cc all the way up to 10 cc. All of these models were made to a common basic design. A considerable number were manufactured for use by the Hitler Youth organization in promoting air-mindedness among its members. Production of these well-designed and finely-made engines continued for

some time after the war.

In passing, it seems worth commenting upon the surprising degree to which model diesel experimentation and manufacture continued in Germany well into the wartime period. Names like Eisfeld, Kratmo, Kemmerling, Thusius and Mack-Madie come immediately to mind, and there may have been others. Even the famed Mercedes automobile company got into the act by making a high-quality one-off model diesel engine for none other than former WW1 aviator Hermann Goering!

Returning now to the pre-war period, Gustav Eisfeld's abandonment of his original 1937 diesel project left the way open for Ernst Thalheim to introduce the first commercial model diesels, which he did in 1938, ten years after the granting of his original patent. His ETHA engines were large, heavy and cumbersome. However, they were reportedly very competently constructed and ran well, thus proving the concept for all to see.

The technological success of the ETHA engines naturally inspired others to have a go for themselves. The Dyno 2 cc model manufactured in Switzerland by Klemenz-Schenk was one of the earliest spin-off products, being developed between 1938 and 1940 and making its market debut in 1941. It was a considerable step forward from the ETHA designs, being both smaller and lighter as well as having a higher specific power output. As time went on, the Dyno became one of the most widely-imitated early model diesel designs of them all. The number of surviving Dyno copies and clones doubtless exceeds the number of originals by a considerable margin!

The trend-setting Swiss Dyno 2 cc diesel

Despite the fact that by the early 1940's most of Europe was heavily embroiled in WW2, word about this then-innovative type of model engine somehow trickled out of neutral Switzerland to reach a number of other European countries, both neutral and occupied.

News of the new technology also reached neutral Sweden in 1942, along with an actual example of the Dyno 2 cc engine which somehow crossed war-torn Europe to come into the possession of Gunnar Fahlnäs, then the editor of the popular Swedish technical magazine "Teknik för Alla", which was widely circulated in all of the Scandinavian countries. Impressed with the performance of his Dyno, Fahlnäs commissioned the talented Swedish model engineer Ivan Rogstadius to develop a Dyno-based design for home construction, using his original Dyno as the prototype. Plans were drawn up during the winter of 1942/43, after which several engines were constructed by Rogstadius.

Ivan Rogstadius was soon followed by other Swedish model diesel experimenters. AS Giancarlo Pinotti, in yet another article to be found on this website. There was also the 1944 Västerås diesel 2 cc model produced by the Västerås-based Johansson brothers, which was the precursor of the Komet range. In addition, the Swedish model dealer Hobbycirklarna of Stockholm somehow managed to arrange for the importation of a number of Dyno diesels to Sweden in 1944, as an advertisement from the September 1944 issue of "Teknik för Alla" proves beyond doubt.

Finally, in 1944 the Stockholm model supply house of Svedfeld & Co. began advertising a model diesel which bore a striking resemblance to the Rogstadius design. Although this was apparently referred to by Svedfeld as the "Typhoon" model, the illustration which accompanied the advertisement bears the unmistakable Rogstadius stamp.

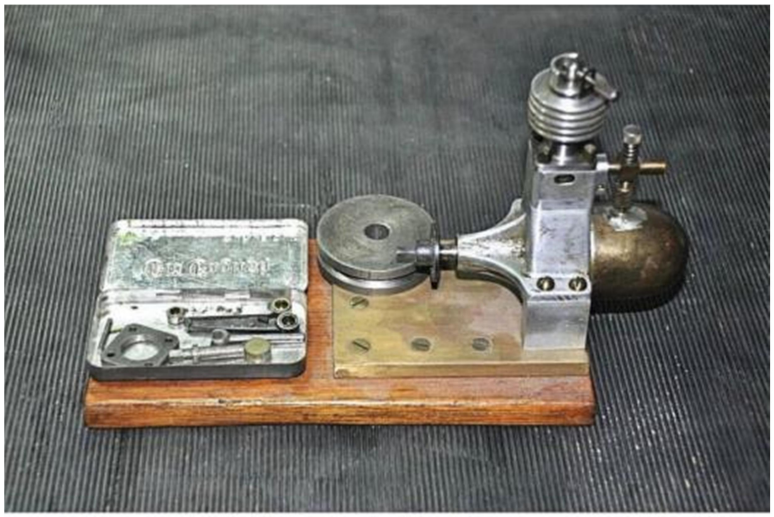
Despite the fact that both Norway and Denmark were under German occupation at this time, some information regarding model engine developments in other countries was sporadically available to enthusiasts in those countries from German, Swedish and Swiss sources. In Norway, Jan David-Andersen first became aware of the application of compression ignition to model engines in 1943, most probably from his reading of Ivan Rogstadius's 1943 articles in "Teknik för Alla", which remained in publication throughout the war and was read throughout Scandinavia.

Pinotti GP 1.5 cc diesel

Pioneering Developments in Denmark

Throughout this unhappy period, ordinary Danes struggled to maintain as normal a lifestyle as possible. A vibrant aeromodelling community had existed in Denmark prior to the outbreak of war, and a surprising level of modelling activity

continued throughout the occupation. Modelflyver motorer (model aero engines) were of course in extremely short supply, prompting a few suitably-equipped enthusiasts to build their own Dyno clones based upon Ivan Rogstadius's previously-mentioned 1943 article in "Teknik för Alla".



Danish-made Dyno copy (Luis Petersen)

An example of one of these units is pictured at the left. This very well-made example is one of a few such engines which were constructed by employees at the Danish Marine Workshop on the basis of Ivan Rogstadius's plans.

When the subject of commercially-produced Danish model engines comes up nowadays, most people from outside Denmark immediately think of the Viking range and stop there.

However, the Viking engines were actually relative late-comers. The fact is that Denmark was as well supplied with a diverse choice of domestic model engines as any other country during the wartime and early post-war periods, long before Viking arrived on the scene. Until 1947, when control-line flying reached Denmark, most of these early engines were used in tether cars, boats and free flight model aircraft. The illustrated tether car track at Kastrup, near Copenhagen, was a popular facility which remained in use into the late 1950's.

Tether car track at Kastrup, Denmark

Although a few model engines may have been made in Denmark during the early to mid 1930's, the country's first documented commercial-scale model engine manufacturer appears to have been Carl Rose, who had a pre-war hobby supply business called Modelmateriale located in Tarm on Denmark's west coast. Rose entered the model engine field prior to the outbreak of war with a series of spark ignition models which first appeared in 1938. He went on to produce a number of very well-made model engines under the CEROS brand name (an anagram for his own family name and initial).

CEROS 3.5 cc spark ignition unit (Luis Petersen)

By the outbreak of war, Rose had reportedly sold some 200 CEROS model spark ignition engines having displacements ranging from 4 cc to 10 cc. When the supply of miniature spark plugs dried up following the outbreak of WW2 and the subsequent occupation of Denmark, Rose began experimenting with model diesels, reportedly making his first such engine in 1940. However, he does not appear to have followed up on this concept until some time after the war, leaving the field open for others in the interim.

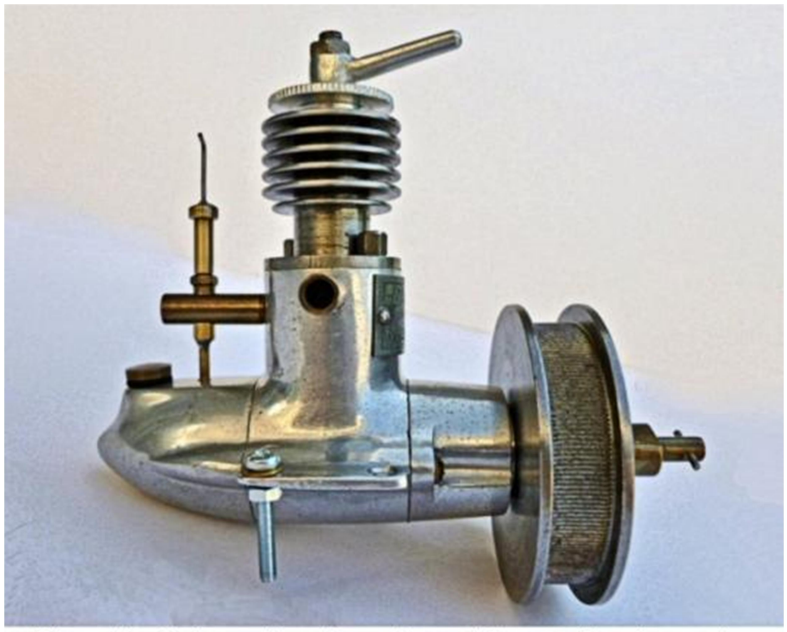
It seems worth mentioning that an example of Rose's very first model diesel from 1940 was still retained at the CEROS factory when it was visited in the winter of 1950/51 by staff of the Danish modelling magazine "Teknik for Alle". The engine had clearly seen a lot of use, because it had reportedly accumulated over 100 running hours by that time. According to the writer of the report on this visit, which appeared in the February 1951 issue of the magazine, this engine remained in perfect condition despite all this running.

In 1946, following the conclusion of WW2, Rose established a small precision engineering business in premises located at Håbets Allé 10 in Brønshøj, a suburb of Copenhagen. The primary business of his new operation was apparently the manufacture of precision mechanical components for the radio industry. However, model engines were in Rose's blood, and a proportion of the company's equipment and human resources continued to be applied to the small-scale production of model engines on the side.

During the early post-war period, Rose returned to the manufacture of spark ignition engines, then still in widespread use in the mid and larger displacement categories. There were 3.5 cc and 4.7 cc models of this type. However, Rose was quick to recognize the sweeping impact of Ray Arden's late 1947 introduction of the commercial miniature glow-plug, and a CEROS 4.9 cc glow-plug unit duly appeared in 1949. This was heavily influenced by the design of the far smaller K&B Infant .020 cuin. model which had appeared in the USA in late 1948.

Soon after the 4.9 cc glow-plug model appeared, Rose returned to the diesel fold. There was a neat and compact 2.5 cc crankshaft front rotary valve (FRV) diesel model, while the final CEROS product by that name was a 3.5 cc diesel which appeared in the winter of 1950/51. This model bore a striking resemblance both in design and appearance to the contemporary AMCO 3.5 PB model from England.

Although they were manufactured in relatively small quantities, the CEROS engines acquired a



Diesella 2.4 cc diesel equipped for car/boat service

good reputation among Danish modellers - note the CEROS advertisement in the previously-reproduced photo of the Kastrup tether car track. At the present time, it is not possible to state with any authority exactly when CEROS model engine production ended. It's also perhaps worth mentioning in passing that the 3.5 cc diesel may not have been the final product of Carl Rose's involvement with model engines. Sven E. Truedsson's 1956 Swedish catalogue included an entry for a Danish-made 2.5 cc twin ball-race diesel called the Jaguar 2.5 BB. To all appearances this was pretty much a clone of the very successful Webra Mach I from Germany, although it did possess a few refinements such as a hardchromed bore and a bronze insert in the cooling jacket for the comp screw. It was easily distinguishable from the Webra by its red-painted crankcase. The extreme present-day rarity of this engine implies that very few were made.

Although the actual manufacturer of the Jaguar 2.5 BB was not named in Truedsson's catalogue entry, there is some evidence that Carl Rose may have been responsible for this engine. The CEROS 3.5 cc diesel model mentioned above had a very similar cylinder porting arrangement. A reference has been founderence to Rose having made a limited number of smaller units (i.e., less than 3.5 cc) specifically for team racing. It seems not unlikely that the Jaguar 2.5 BB was that very engine.

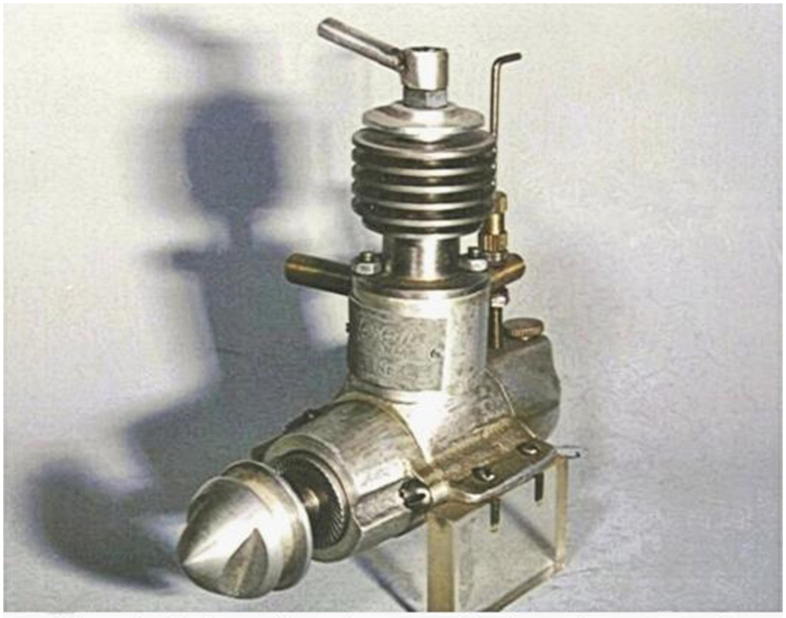
Returning now to the wartime period, the first commercially-produced model diesel in Denmark seems to have been the Diesella 2.4 cc model. According to a Danish-language article by the then well-known Danish model flier Peter Christiansen which appeared in the January 1944 issue of the magazine "Flyv", this pioneering model diesel was the product of a collaboration between Eli Andersen and one A. Jeppesen, two mechanically-gifted individuals who had reportedly been building their own model spark ignition engines of varying displacements since 1938. In early 1943, the impossibility of obtaining miniature spark plugs under wartime conditions led the two men to commence their experiments with model compression ignition engines. By the latter part of 1943 they had a design which they felt merited series production. At that point in time, Eli Andersen (then aged 28 years) established a small workshop in the town of Kolding, applying the Diesella trade-name to the engines which were manufactured there by himself and Jeppesen.

The original 1943 Diesella workshop in Kolding

The fledgling Diesella company was located in a tiny workshop on Sydbanegade which seemed barely large enough to accommodate the two men and their equipment! The primary business at this point was clearly the manufacture of model engines, since the sign on the storefront proudly proclaimed that the premises were occupied by a "Fabrik for Modelflyvermotorer"

According to the previously-noted January 1944 "Flyv" article, the Diesella 2.5 cc model entered production in November 1943. This almost certainly made it the first model diesel to enter commercial production not only in Denmark but in any Scandinavian country, since Sweden's first commercially manufactured diesel, the Pinotti GP 1.5 cc model, did not enter series production until early 1944, while Norway's first series manufacturer Øivind Andersen did not enter the market until a little later in 1944.

The fact that Eli Andersen saw commercial potential in the introduction of a model diesel at this time is significant in that it clearly indicates the existence in Denmark of a ready market for such products even under increasingly harsh wartime conditions. This in turn implies that aeromodelling remained alive and well despite the progressively more difficult conditions of the occupation.


Diesella 2.4 cc diesel - note single exhaust stack

The perceived strength of the market which existed at this time is underscored by the fact that Eli Andersen felt able to set the price of the Diesella at no less than 115 Danish kroner. To put this in perspective. In 1940 a 3 room flat could be rented in Denmark for 85 kr./month!

Despite its high selling price, the Diesella attracted quite a few buyers because it had no domestic competition at the outset. While retaining a certain degree of Dyno influence, the Diesella embodied a number of original design features

and was considerably “prettied up”. A notable feature was its massive streamlined main bearing housing which featured a recessed prop driver along with a ball race crankshaft.

The engine's styling was complemented by a nicely streamlined metal fuel tank at the rear. The visual effect which this streamlining created was quite pleasing. The engine was also distinguished by having a single exhaust port discharging through a tubular stack on the right hand side of the upper crankcase. Some examples seems to have had twin exhausts.

Reported bore and stroke measurements of this engine were 13 mm and 18 mm respectively for a nominal displacement of 2.39 cc. Although it is generally (and correctly) referred to as a 2.4 cc unit, the manufacturer’s identification plate claimed that this model had a displacement of a full 2.5 cc. The engine weighed in at a fairly healthy 200 gr. ready to fly. Cited output was 1/6 BHP @ 4,500 rpm. If accurate, this figure implied a pretty serious level of low-end torque development, The Diesella engines were reputedly very well made. However, their further development stagnated after the war as Eli Andersen became interested in expanding the scope of the business during the early post-war period. Consequently, it appears that only some 200 examples of the Diesella 2.4 cc model diesel ended up being manufactured, making it an extremely rare engine today. As with most other Danish model engines at this time, many of these units were equipped with flywheels for car or boat use. A few examples seem to have been converted to glow-plug operation at a later date.

In 1946, in partnership with his brother Arne and with the financial support of his businessman father Marinus Andersen of Lunderskov, Eli Andersen established a significantly larger manufacturing facility on Agtrupvej, still in Kolding. The Andersens had long had an interest in autocycles, going back in Eli’s case to 1927 when he constructed his first such vehicle at the tender age of 12 years using an old motorcycle engine, a used pram wheel and a drive belt “borrowed” from the coffee grinding mill in his father’s grocery store in Lunderskov! Once established in their enlarged premises, the Andersen brothers’ attention soon switched to this line of business, which appeared commercially promising due to the fact that one needed a permit to buy a car in post-war Denmark. Such permits were difficult to get, making the autocycle (knallert) or moped an attractive and affordable transportation alternative.

12-year old Eli Andersen testing his first autocycle Lunderskov, Denmark, 1927

The Diesella company was in fact destined to become best known for its involvement in the autocycle and moped business. One of its first products in that line was a 50 cc two-stroke engine which could be mounted on a standard bicycle to drive the rear wheel

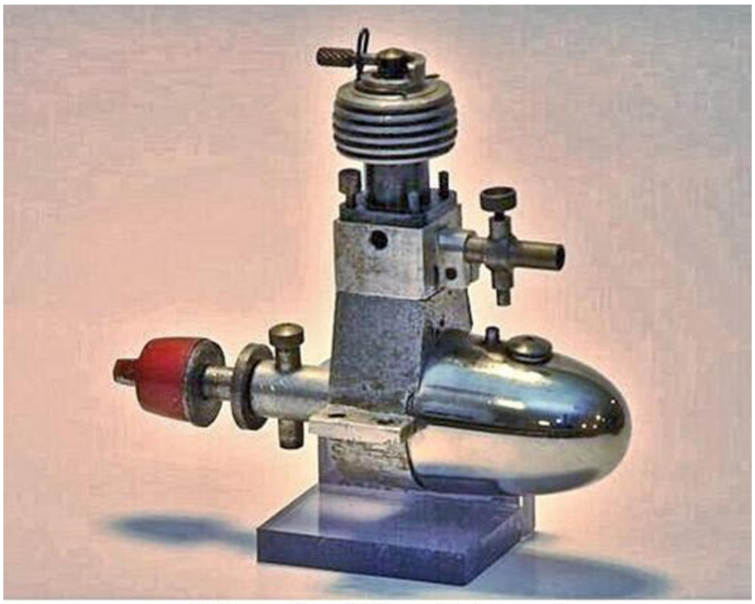
through a roller applied directly to the tire. The Diesella company grew fast in the early post-war period, mainly on the strength of their very successful autocycle engines. They rapidly lost interest in commercial model engine production, dropping the Diesella model diesel series fairly soon after the conclusion of WW2, although they did briefly introduce a pulse jet unit in early 1948. This was basically a clone of the Dynajet model from America. Only around 100 examples wound up being made before Diesella's involvement with model engines ended for good.

Diesella pulse jet

Diesella eventually became Denmark's largest manufacturer of mopeds and autocycles, peaking in the mid 1960's with annual sales of some 40,000 units.

A competing Danish engine which appeared in 1944 was the 2 cc Mikro-diesel. This engine was manufactured by Kai Nielsen of Kronprinsensgade 8, Copenhagen who had established his own business in 1938 primarily as a repair workshop for photographic equipment. His original equipment consisted of a single turret lathe!

The idea of Nielsen producing a model diesel apparently stemmed from one of his employees, who showed up at work one day in 1944 with a Swiss Dyno diesel which he had somehow obtained. Like most of the model diesels which appeared at this time, the original Mikro model was basically another Dyno clone which appeared to owe much to Ivan Rogstadius's published plans. It weighed in at 220 gr. and developed a claimed 1/10 BHP @ 7,500 RPM - a somewhat more credible claim than that made for the Diesella! Most of these engines were apparently used in the 2 cc tether car racing class.



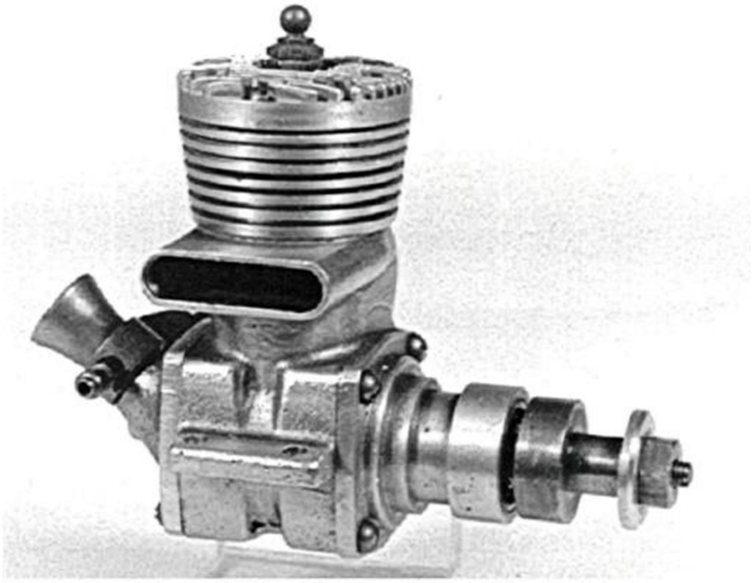
Mikro diesel (Luis Petersen)

A very neat feature of this engine was the wire clip which circled the top of the cylinder head and had a vertical extension which engaged with the compression screw lever. This was a very simple and effective means of discouraging the comp screw from

running back during operation.

It appears that Kai Nielsen did not pursue the manufacture of the Mikro diesel with any great vigour. Only around 250 examples of the original sideport Mikro-I model seemingly ended up being produced.

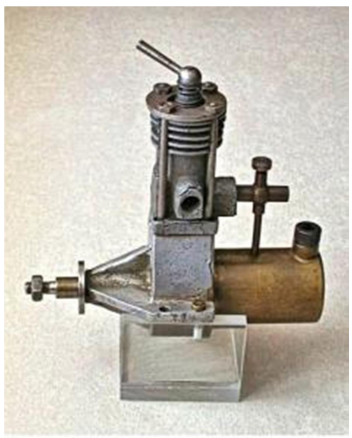
In 1949 a comprehensively revised 2 cc Mikro-II model featuring crankshaft front rotary valve (FRV) induction appeared to replace the earlier model. This engine was apparently designed by an engineering colleague of Nielsen's named Henriques. However, there were many problems with the original version of this model. The cylinder was made too thin - it tended to split. The contra-piston was somewhat awkwardly adjusted by rotating the entire cooling jacket by means of a tommy bar which was inserted into one of a number of holes drilled radially in the cooling fins around the jacket's circumference. In addition, the motor was provided with only two holes for mounting, a detail that probably originated from the engine's use in model race cars.



Mikro 5 cc racing engine

Design revisions were soon put in hand to address these issues, but the damage had been done. A planned production series of 1,000 units was apparently started, but only about 200 examples ended up being completed.

In the following year of 1950, Nielsen introduced a potent-looking Mikro 5 cc racing glow-plug unit. This too was designed by Nielsen's colleague Henriques. Its design owed much to the various leading American designs of the period, particularly the Dooling. However, its actual reported output of only 0.35 BHP @ 16,000 RPM was not competitive, and Nielsen appears to have abandoned the model engine field after perhaps 500 or so examples had been made.



Deofok 45 1.8 cc diesel (Luis Petersen)

Another pioneering Danish model engine from the early post-war period was the Deofok 45 design, which was introduced in 1945 by the brothers Carl & Leif Kofoed of Copenhagen. The name Deofok was of course their family name spelled backwards, while the engine's numerical designation seems to record the year of its introduction rather than its displacement, which was 1.8 cc. The Deofok 45 was a sideport diesel of more or less conventional layout. Only some 20 examples of the Mk. I version of this mega-rare engine were manufactured before a Mk. II model, also of 1.8 cc

displacement, was introduced in 1946. It too was manufactured in very low numbers.

The brothers later produced very small numbers of a Deofok III model of only 0.25 cc displacement. They also made a single example of a 5 cylinder four-stroke glow-plug radial model. This engine was subsequently stolen from the home of the widow of one of the Kofoed brothers, along with the machinery used to make the engines.

An individual whose activities were to play a not unimportant role in the story of Danish modelling in general and the Viking model engine range in particular, was Svend Herborg Greig. Prior to 1937, Greig had worked with the previously-mentioned Carl Rose of CEROS fame in his prewar Modelmateriale hobby supply business in Tarm on Denmark's west coast.

Svend Greig working at DMI - 1943

According to Greig's own published account, a 1937 falling-out between Rose and Greig over Rose's unattributed use of a Greig model design for his own promotional purposes led to Greig deciding to start his own business. He began by buying Rose's existing business to clear accounts between them, but Rose promptly started another business in competition with Greig. That business too was purchased by Greig, who thus claimed to have ended up buying Rose out twice!

Greig's new business was known as Dansk Modellflyve Industri (DMI - Danish Model Aero Industries). The venture began as a part-time business conducted out of Greig's father's attic, but soon expanded to the point where it became a full-time activity. In 1938, new premises were secured in Skjern, with a further move being made in 1942 to the company's final location in Odense, a city located in south-central Denmark on the island of Fyn. DMI was primarily a kit producer, but the company supplied a wide range of modelling goods both from Danish sources and elsewhere. Supplies of certain products such as power rubber for free flight models (which had come from England) were disrupted by the war, but the company managed to remain active throughout the war years and well into the post-war era.

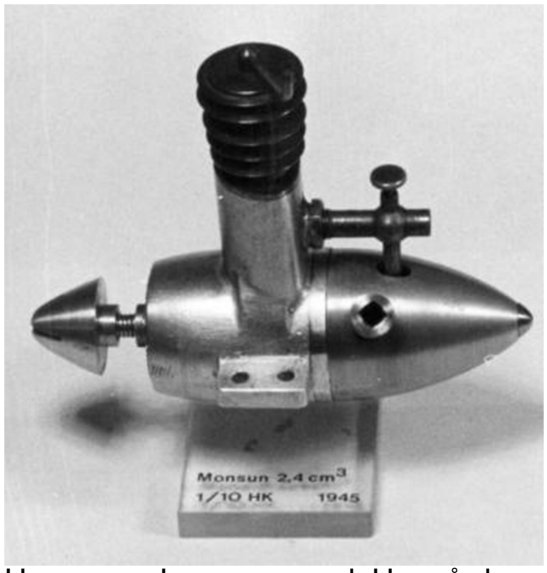
Interestingly enough, in that 1943 article Greig recalled that long after the war began he was still able to obtain supplies of balsa wood from Hamburg, Germany. He also obtained a variety of modelling materials through Sven Wentzel in Stockholm, Sweden. The presence of balsa wood in Hamburg was due primarily to the fact that it was used as insulation in U-boat hulls. A U-Boat facility was also established in Denmark during the war.

During the early post-war period, Greig elected to go into competition once again with his old rival Carl Rose of CEROS by entering the model engine business himself. He did so with a

Greig G2 reproduction by Kjell Lindqvist (Sweden)

range of model diesel engines which were sold in kit form as sets of castings and drawings for home construction. Models available in this form included the Greig G1 of 2.5 cc displacement, the 4.0 cc Greig G2 and the daunting 10 cc Greig G3. Later there was also a pioneering turbojet design which was not successful.

DMI was to go on to become Denmark's largest distributor of modelling goods, including engines. The business was taken over by Svend Schou in around 1948, but continued much as it had before. Greig went on to operate a new hobby supply business in Odense called Greig Hobby.



. One of Denmark's most prominent model engine ranges from the early post-war period was the series of engines which were manufactured under various names by Thorning Bensen, a former employee of the major shipyard at Helsingør, a city in eastern Denmark lying on the coast some distance to the north of Copenhagen. Before entering the model engine manufacturing field on a full time basis in the latter part of 1945, Bensen worked as a machinist at the shipyard alongside another individual named Leo Jeppesen, an engineer employed on full-sized marine diesel design. Jeppesen's design colleague was fellow engineer Bent Haugård.

Thorning Bensen was not himself a modeller - he was primarily interested in machining challenges. However, Jeppesen and Haugård were close acquaintances of two of Denmark's leading power modellers, Jørgen Dommergaard and Peter Christiansen. These two individuals were both early proponents of model diesels - indeed, Christiansen had written the previously-cited article about the Diesella which appeared as early as January 1944.

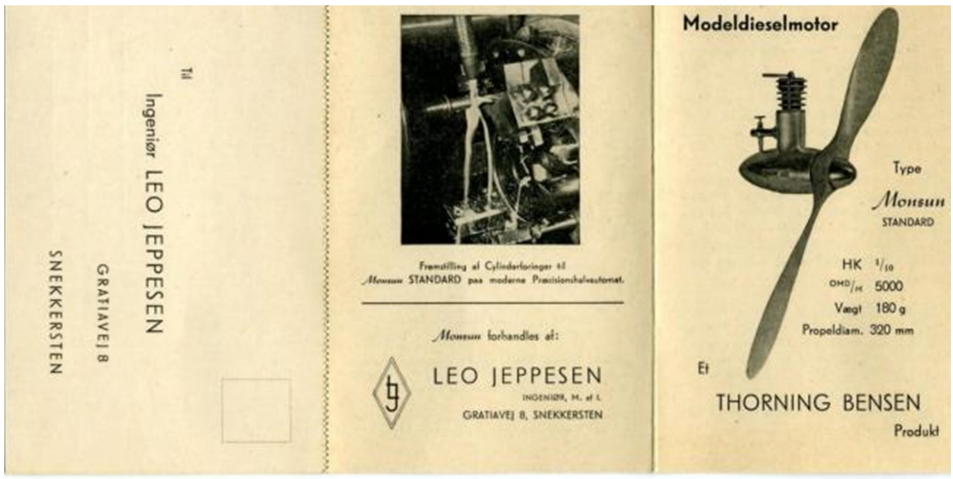
As one of Denmark's pioneering diesel users, Dommergaard soon developed some very definite ideas of his own regarding model diesel design. Beginning in early 1944 he began to collaborate with Jeppesen and Haugård on the design of a 2.4 cc sideport diesel which they called the Monsun (Monsoon) Standard. While still seemingly paying homage to the Dyno in basic design terms, the Monsun Standard was apparently just as strongly influenced by the

Diesella, at least in terms of its external styling.

However, internally it was a very different story! The engine's rather unique scavenging and timing arrangements were not influenced by any previous model engine but rather were derived from those of a DKW two-stroke car engine which had been designed by a Danish engineer, Jørgen Skafte Rasmussen. DKW was later to evolve into the Audi car line. For those interested, a discussion of the Monsun's highly original porting arrangements (in a model engine context) may be found here on Ron Chernich's "Model Engine News" (MEN) web-site.

Externally, the Monsun Standard shared the Diesella's streamlined back tank and massive main bearing housing with recessed prop driver, although some of the construction details differed, such as the omission of the ball races which had been a feature of the Diesella. Dommergaard did not consider ball races to be worthwhile, contending that a well-fitted bronze bushing worked just as well.

A preliminary prototype was completed in early 1945, but this proved far from satisfactory. However, changes were soon made, resulting in the evolution of an improved design by mid 1945. Leo Jeppesen and Bent Haugård then supervised the construction of a few more prototypes, with the machining being carried out by Thorning Bensen at the shipyard. These prototypes were extremely well made. One of them was subjected to a bench running test totalling over 100 hours in duration. This particular prototype still exists at the Stauning airplane museum. Despite the running time which it has accumulated, it remains in perfect condition.



Monsun Standard promotional material

Other prototypes were thoroughly flight-tested by Dommergaard and Peter Christiansen, who reportedly accumulated over 20 trouble-free running hours on one of the engines in the air. In the latter half of 1945, once this testing was completed, Jeppesen drew up the engineering plans upon which the production models would be based.

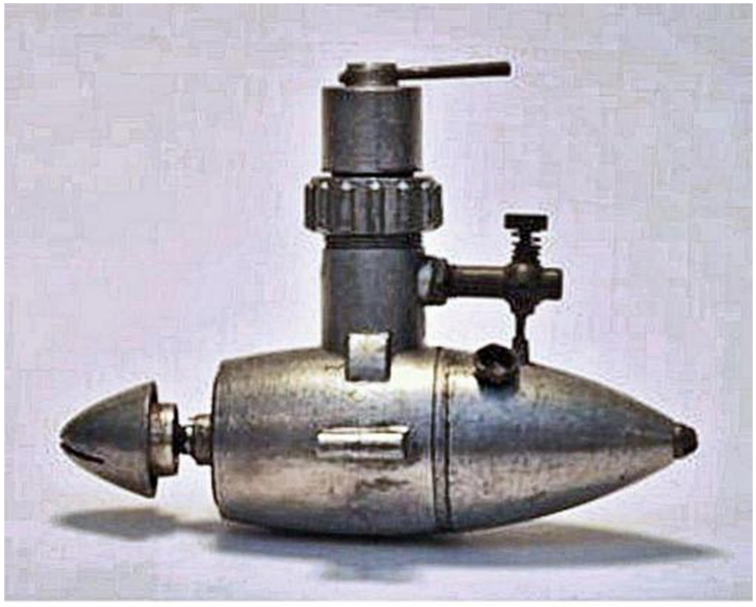
Although as stated earlier he was a machinist rather than a modeller, Thorning Bensen was greatly attracted to the technical challenge of producing model diesel engines to the required standard of precision. He was also very keen to start out in business on his own account. This led him to take on the task of manufacturing the engines at his own workshop which he established in the latter part of 1945 in a basement on Mads Holms vej in Helsingør. Leo

Jeppesen assumed responsibility for the marketing of the finished products.

The promotional material for the Monsun reflected this division of responsibilities, specifically citing the engine as a Thorning Bensen product while giving the business address of the venture as that of Leo Jeppesen at Gratiavej 8 in Snekkersten, effectively a suburb of Helsingør lying a little to the south of the main city.

However, the quality of the engines suffered greatly through this change of manufacturing venue, possibly as a result of the accelerated production schedule required to meet demand coupled with the fact that Bensen was working alone at this time and possibly using rather basic and perhaps well-worn equipment during this start-up phase. The use of inferior materials may also have contributed to this deterioration. The original prototype materials came from the shipyard, but those available to Bensen from other sources may well have been sub-standard.

Whatever the reason, this deterioration in quality led Leo Jeppesen to withdraw from the project quite early on, although he retained his original drawings, which still exist today. Thereafter, Thorning Bensen continued on his own. Around 100 examples of the Monsun Standard ended up being manufactured by Bensen, although most of them were of a far lesser quality than the original prototypes. There are no known survivors of this series today.



Thorning III diesel

The Thorning Bensen 1A was in essence a Monsun Standard without the cooling fins and with a slightly modified cylinder assembly using a “dog collar" for attachment. It also used the moving jacket system for compression adjustment, whereby the contra piston was moved by the rotation of the jacket upon its installation thread rather than by a centrally-located comp screw.

Thorning Bensen made some changes to this design in order to simplify its manufacture somewhat. He then made preparations to go into larger-scale production, acquiring some new equipment and taking on two additional workers besides himself. In late 1946 he began production of the engine with which his name is most widely associated today - the Thorning III sideport diesel. For reasons which are now obscure, the Bensen portion of the name was dropped at this time, never to reappear.

The Thorning III is undoubtedly the best known member of this series since it was made in relatively large numbers – about 1200 examples in all, some of which found their way beyond the borders of their native Denmark. Despite their admittedly unconventional appearance,

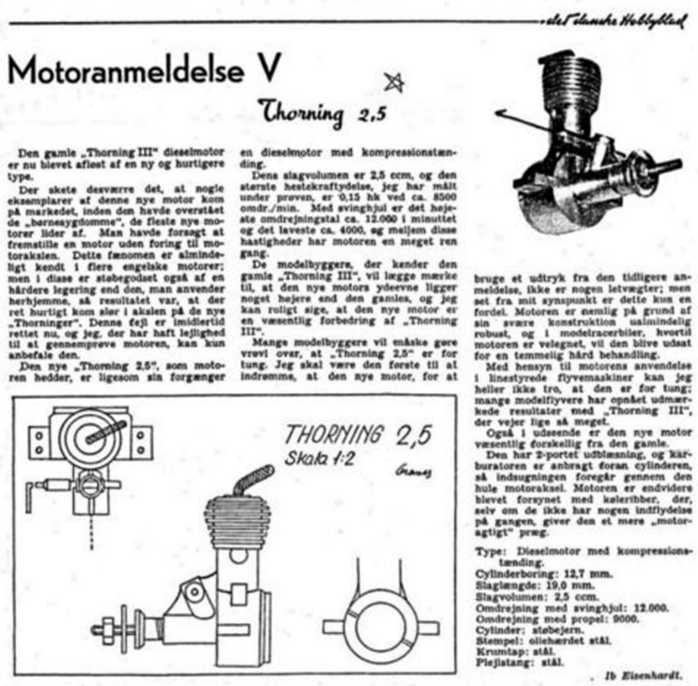
these engines ran (and still run!) very well. They were also quite well made - seemingly, Bensen had got on top of his earlier quality problems to a large extent, perhaps thanks to his new equipment.

The engine was a steady seller right from the start, becoming the most widely-used model engine in Denmark for some years. Thorning Bensen recalled that the engine won several Danish championships, also establishing a few Danish records along the way. Its high point was apparently a 3rd place finish in an unspecified International control-line competition. It was marketed by the aforementioned DMI company.

The engine is easy to start on all props tested. A peak output of 0.112 BHP was measured between 6,000 and 7,000 RPM. The recommended fuel was apparently 60% ether, 20% kerosene and 20% motor oil. The engine's excellent starting and running qualities as well as its durability assured it of a ready market throughout the balance of the 1940's and into 1950.

In late 1949 Bensen produced a prototype of a planned 2.5 cc crankshaft front rotary valve (FRV) replacement for the increasingly out-dated Thorning III sideport model. This appears to have been a response to the news of the incipient release of the competing Viking 2.5 cc design, of which much more below in its place.

This original FRV prototype retained the "dog collar" cylinder attachment system of its predecessor. Leo Jeppesen's original drawings from 1944 had included just such a variant, and now Thorning Bensen began experimenting with his own rendition of this design.



Motoranmeldelse V

Thorning 2,5

Den gamle „Thorning III" dieselmotor er nu blevet afløst af en ny og hurtigere type.

Der skete desværre det, at nogle eksemplarer af denne nye motor kom på markedet, inden den havde overstået de „børnesygdomme", de fleste nye motorer lider af. Man havde forsøgt at fremstille en motor uden foring til motorakslen. Dette fænomen er almindeligt kendt i flere engelske motorer; men i disse er støbegodset også af en hårdere legering end den, man anvender herhjemme, så resultatet var, at der ret hurtigt kom slør i akslen på de nye „Thorninger". Denne fejl er imidlertid rettet nu, og jeg, der har haft lejlighed til at gennemprøve motoren, kan kun anbefale den.

Den nye „Thorning 2,5", som motoren hedder, er ligesom sin forgænger en dieselmotor med kompressionstænding.

Dens slagvolumen er 2,5 ccm, og den største hestekraftydelse, jeg har målt under prøven, er 0,15 hk ved ca. 8500 omdr./min. Med svinghjul er det højeste omdrejningstal ca. 12.000 i minuttet og det laveste ca. 4000, og mellem disse hastigheder har motoren en meget ren gang.

De modelbyggere, der kender den gamle „Thorning III", vil lægge mærke til, at den nye motors ydeevne ligger noget højere end den gamles, og jeg kan roligt sige, at den nye motor er en væsentlig forbedring af „Thorning III".

Mange modelbyggere vil måske gøre vrøvl over, at „Thorning 2,5" er for tung. Jeg skal være den første til at indrømme, at den nye motor, for at bruge et udtryk fra den tidligere anmeldelse, ikke er nogen letvægter; men set fra mit synspunkt er dette kun en fordel. Motoren er nemlig på grund af sin svære konstruktion ualmindelig robust, og i modelracerbiler, hvortil motoren er velegnet, vil den blive udsat for en temmelig hård behandling.

Med hensyn til motorens anvendelse i linestyrede flyvemaskiner kan jeg heller ikke tro, at den er for tung; mange modelflyvere har opnået udmærkede resultater med „Thorning III", der vejer lige så meget.

Også i udseende er den nye motor væsentlig forskellig fra den gamle.

Den har 2-portet udblæsning, og karburatoren er anbragt foran cylinderen, så indsugningen foregår gennem den hule motorakse. Motoren er endvidere blevet forsynet med køleribber, der, selv om de ikke har nogen indflydelse på gangen, giver den et mere „motoragtigt" præg.

Type: Dieselmotor med kompressionstænding.
Cylinderboring: 12,7 mm.
Slaglængde: 19,0 mm.
Slagvolumen: 2,5 ccm.
Omdrejning med svinghjul: 12.000.
Omdrejning med propel: 9000.
Cylinder: støbejern.
Stempel: oliehærdet stål.
Krumtap: stål.
Plejstang: stål.

Ib Eisenhardt.

Second Thorning IV test - "Teknik for Alle", December 1951

Bensen doesn't appear to have followed up on this prototype with any great rapidity. In large part, this appears to have been due to his realizatiuon that the competing Danish manufacturer Carl Rose of CEROS fame, was embarking upon the development of a 3.5 cc diesel. Bensen appears to have set the 2.5 cc project aside and turned his attention to the creation of his own Thorning 3.5 cc FRV model.

This engine was closely modelled upon the design of the very successful AMCO 3.5 PB model

from England. It made its appearance on the Danish market in the latter part of 1950.

The success of the Viking 2.5 cc sideport diesel beginning in early 1950 did not allow Bensen to forget that a response to that model still had to be developed. After getting the 3.5 cc model into production, he resumed work on the 2.5 cc FRV design, making a number of changes along the way. These changes included the elimination of the "dog collar" in favour of a more conventional drop-in cylinder which was retained by a screw-on cooling jacket. In addition, a conventional compression screw was now used instead of the former moving jacket arrangement. The engine now featured twin exhaust ports, one on each side, in place of the Thorning III's single forward-facing exhaust port.

Thorning 2.5 cc FRV diesel

Thorning 3.5 cc diesel

There were apparently some problems with the production of the required permanent molds, but by early 1951 the new 2.5 cc FRV design was finally judged to be ready for release to the public. Production of the venerable Thorning III ended at that point, or possibly a little earlier. Like its 3.5 cc companion, the new 2.5 cc model was identified simply by its displacement - the two designs were called the Thorning 2.5 and 3.5 respectively. The Thorning 2.5 FRV design was the subject of another published test which appeared in the October 1951 issue of the Danish "Teknik for Alle" magazine. The writer of that report measured a peak output of 0.142 BHP @ 8,000 RPM - clearly, Bensen was still pursuing high torque at low RPM, apparently with a certain degree of success! However, the engine came in for a considerable level of criticism from the test reporter, most notably on account of the very rapid wear which developed in the unbushed main bearing. The writer also expressed disappointment at the relatively modest power output, going so far as to state that the new model did not represent any real advance over the trusty Thorning III.

Thorning Bensen moved rapidly to address some of the concerns highlighted in this test, including the

incorporation of a bushing in the main bearing. Although it was on the verge of ceasing publication, the Danish "Teknik for Alle" magazine nonetheless hastened to get a condensed, but still informative addendum report on this revised variant into its December 1951 issue. A slightly improved output of 0.152 BHP @ 8,500 RPM was cited in this test report, together with the observation that the main bearing wear issue had been satisfactorily addressed.

However, the damage had been done. Both engines were advertised as potential gifts for Christmas 1951 by the Hobby Shop at Vesterbrogade 175 in Frederiksberg, near Copenhagen, but the modelling public evidently didn't want to know. The engines could not compete with the lighter and more powerful designs now available from the likes of Viking and various foreign manufacturers. Only about 500 examples of the FRV models were produced prior to the end of 1951, when Thorning Bensen ended all model engine manufacture. He went instead into the business of making printing equipment for newspapers and magazines.

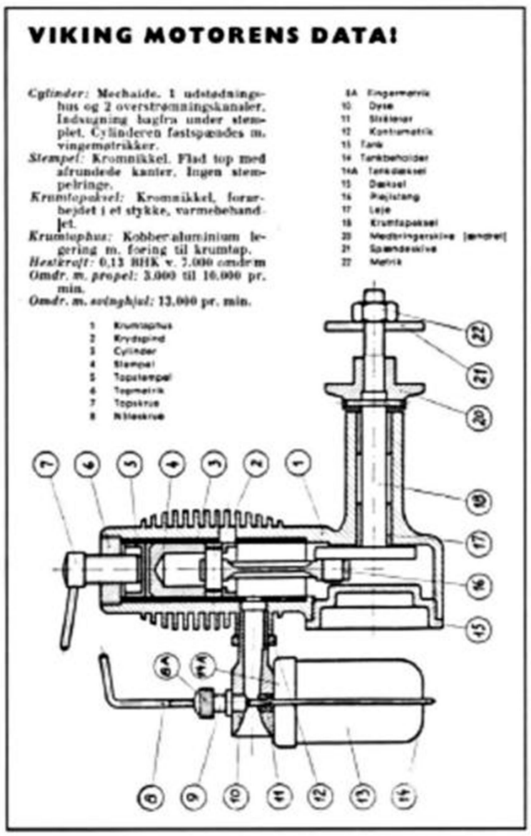
At long last this brings us up to the point at which the Viking range entered the picture, an event which took place in early 1950. By that time the Diesella, Deofok and Mikro diesels were history, but the Thorning and CEROS models as well as the Greig engine kits were still in circulation. This was the domestic competition that the Viking range had to face.

The Viking Range

The first Viking model engine - Viking 2.5 cc diesel

The Viking marque remains alive and well on the flying fields of Denmark, 66 years after its establishment. No doubt Christian Tommerup Clausen, CTC, would be very happy to know this!

Tommerup Clausen had a factory at Lundbyvej in the northern part of Fyn. The facilities were housed in a former nursery! The workshop equipment included lathes, milling machines, grinding equipment and honing machines. Using this equipment, Clausen manufactured an amazingly diverse range of products, including complete gramophones, tools, window fittings and parts for vacuum cleaners and milking machines. However, his most famous products were probably the Viking model engines, which were produced from 1950 to the late nineteen-sixties.



Viking 2.5 cc G/A section and parts list

The staff consisted of a foreman, a few journeymen and a succession of apprentices and boys. The first Viking engine, a 2.5 cc sideport design of which much more later, was constructed by Clausen at the beginning of 1950 following consultation with some members of the Odense Model Flying Club. It was inspired by the earlier Thorning III model and other similar designs, although it actually displayed considerable design originality. It's an indication of the way in which Clausen worked at this time, that the design drawings were made with chalk on the workbench! It was only around 1958 or 1959 that the first proper engineering drawings were produced by one of the apprentices.

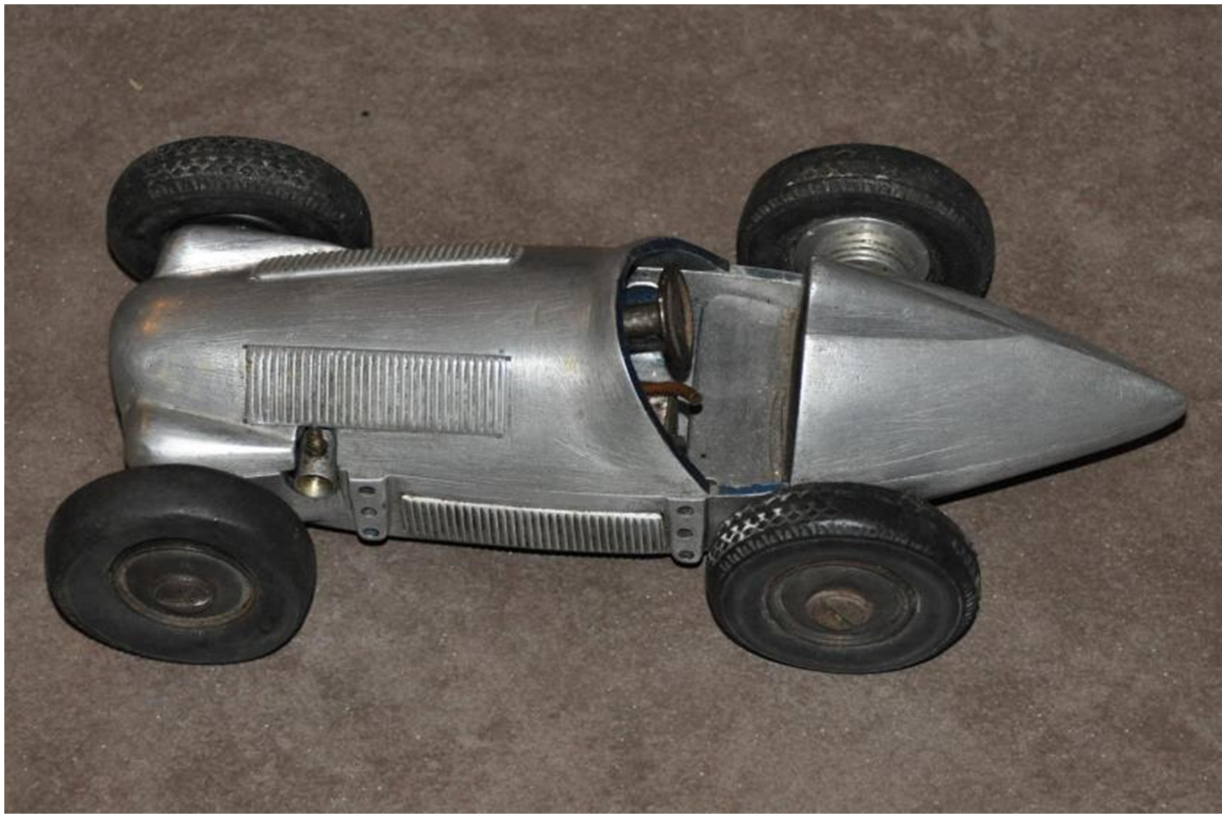
The crankshafts were turned from the material of an old automotive half-shaft, then nitride-hardened in a cyanide bath. The use of old half-shafts was in fact very common at this time.

The crankcases were cast after discussions with the Kramer foundry, who made the early castings. Clausen later established his own foundry to make crankcases and other cast components.

Cylinder sets were machined, honed, measured, sorted and then lapped to a final fit with Brasso. The latter step was one of the earliest apprentice duties. Clausen also ensured that all engines were test-run prior to dispatch. Every Thursday, he delivered the weekly production of an average of 25 units to the sales agency for the Viking range. This was none other than our earlier acquaintance DMI, which by then was owned by the previously-mentioned Svend Schou. The original selling price was 27 kr., and this transaction provided Clausen with the wages for the week, which were due on the following day - Friday!

During testing of the engines, a form of vibration tachometer was used. This consisted of a rod having a number of protruding wires of various lengths fixed to it. A given length and thickness of wire has its own resonant frequency at which it vibrates. Clausen established a standard for his engines, and each engine could be checked using this device to ensure that it met the standard by causing the appropriate wire to vibrate while running.

Eventually one of the apprentices learned to pick the "good" engines. He was a model car enthusiast, and he installed a good 'un in a small shaft-drive car of a type known in Scandinavian model car racing circles as a "Toad" (a generic term used in the Scandinavian countries to denote an American-style "teardrop" tether car - in Swedish for example, "padda" - A.D.) He used this vehicle to set a course record at an Odense model car club. Unfortunately for him, when the other club members learned where he was working, his performance was nullified on the grounds that he was a "professional"!!



A total of 5 Viking models were manufactured over the 19 years during which production continued. The final total produced was reportedly some 25,000 engines of all types combined.

Viking 2.5 diesel – 1950 – 1969

This well-made and in some ways considerably out-of-the-rut sideport model is the design for which the Viking name (and indeed the Danish model engine manufacturing industry) is best known today in the world outside of Denmark. It was both the first and last model engine produced by Tommerup Clausen's factory, remaining in production throughout the life of the Viking model engine range from 1950 to 1969. The initial retail price was 27 kr., but this soon rose to a more economically-rational 54 kr. By the time of publication of the 1968 catalog from DMI, the stated cost was 87 kr.

Considering its introductory date, it's a remarkable fact that a total of some 20,000 examples of this retrospective sideport design ended up being produced over its almost twenty-year production life. These are noteworthy statistics for a model engine design which was basically outdated at the outset from a technical perspective. The only parallels that we can think of were the E.D. 2 cc sideport models from England and the Mills .75 and 1.3 sideport models from the same country. All three of those models emulated the Viking by remaining in production long after they were totally outdated in design terms.

The reasons for the widespread long-term use of the Viking 2.5 cc diesel by Scandinavian

modellers were closely parallel to the reasons for the ongoing use of the E.D. and Mills sideport engines in Britain and elsewhere. The Viking engines were well made, sufficiently robust, easy starting, dependable, reasonably priced and well marketed, so that owners could easily get spare parts from all Danish hobby shops. Even as late as 1979, some ten years after the final withdrawal of the Viking 2.5 cc model, it remained possible to find new spare parts in some model stores.

The Viking 2.5 cc diesel was an exaggeratedly long-stroke unit featuring bore and stroke measurements of 12.72 mm and 19.50 mm respectively for a displacement of 2.48 cc. These figures were actually borrowed from the earlier Thorning III model (which remained in production at the time when the Viking 2.5 first appeared). The engine weighed a quite reasonable 145 gm (5.12 ounces) complete with tank. Claimed output was 0.15 BHP @ 6,000 rpm. This was very definitely a low-revving long-stroke unit whose strong suit was the development of high torque at low speeds.

The cylinder porting design of the Viking was also copied more or less directly from that of the Thorning III. This included perhaps both models' most unusual feature, namely a single forward-facing exhaust port, which can be clearly seen in the attached images. This feature was well out of the rut in 1950, but it did reappear much later in high performance Russian team race diesels. The intention there was to place the hottest region of the cylinder in the least obstructed direct cooling air-flow. It would of course have the same effect when applied to the Thorning and Viking designs.

The detail and workmanship displayed in the Viking 2.5 were first class. The way in which the lower fins were flared into the inlet boss at the rear is particularly noteworthy. Cutting those fins in this configuration required that they be formed with a slitting saw (or possibly a gang of them) while the crankcase was rotated around the bore axis between very precise limits. Quite a challenging manufacturing step, and one which most manufacturers would probably have sidestepped for cost reasons. That said, it does result in a very attractive appearance. The fuel tank of coloured plastic (blue initially, later red) is also very eye-catching.

Further attention to detail may be seen in the design of the needle valve assembly. All versions of the engine used an externally-threaded steel needle. Prior to the summer of 1953 the engines featured a neat but fragile screw-in cast carburettor body which incorporated both the tank top and an internally-threaded carrier for the needle. The needles used with this carburettor were fitted with a disc which bore against a coil spring fitted around the needle carrier to provide the required needle tension for security of settings.

The rather thin drop-in cylinder liner was retained in the upper cylinder jacket by an externally threaded brass plug that engaged with an internally threaded recess at the top of the cylinder casting. The G/A cut-away section reproduced above should make this clear. The hardened nickel-chrome steel piston had an exaggeratedly-long skirt, which was thought necessary in the early days to ensure adequate compression seal. A number of other early designs such as the original FROG models from England also exhibited this feature.

The centre of the very substantial compression screw is drilled out. The weight saving resulting from this additional manufacturing step is negligible, making it appear likely that the motivation was actually to eliminate any chance of point contact between the screw and the top of the contra piston. This configuration has been shown to significantly reduce the tendency of compression screws to unwind under operating conditions.

Throughout its long production life, the engine was little changed. At the outset, a production rate of 25 units per week was achieved. However, this must have been increased significantly fairly early on, since by September 1952 it was claimed that a total of some 7,000 examples of the Viking 2.5 cc diesel and its low-production 3.2 cc companion (see below) had been sold. As of January 1st, 1956, production figures for all Viking models was said to be around 12,000 units. By 1959 this total (again for all models) had reached a claimed 15,000 units.

Throughout the life of the marque, the 2.5 cc model remained the most enduringly popular member of the Viking family. In all, some 20,000 examples were manufactured prior to the withdrawal of the range in 1969. This represents around 80% of the total number of engines produced for all models.

Viking 3.2 cc diesel

Viking 3.2 diesel – 1950-1951?

It was basically a bored-out version of the 2.5 cc engine described above, nominally retaining the same stroke of 19.50 mm but utilizing a larger bore of 14.4 mm for a displacement of 3.18 cc.

The external appearance of the engine was little changed. The most obvious difference is the larger-diameter unfinned top portion of the cylinder jacket which had to be sized to accommodate the larger-diameter brass disc required to retain the bigger-bore cylinder. The cooling fins are less inwardly tapered at the top to accommodate this feature. The grooves between the fins are also less deeply cut to provide sufficient material for the enlarged installation bore for the cylinder liner. Apart from these relatively subtle differences, it would be very easy to mistake this engine for the more common 2.5 cc model.

The measured bore and stroke are 14.30 mm and 19.65 mm respectively for a displacement of 3.16 cc. Near enough, allowing for "lathe operator's license"!

All examples of this engine were fitted with the original pinned alloy prop driver, also featuring the early combination of a cast carburettor and a blue plastic tank. As noted in our description of the Viking 2.5 cc model, the cast carburettor was all too prone to breakage, and this

example is no exception.

This slightly enlarged version of the standard 2.5 cc model seems to have been intended primarily for car and boat operation, since most of the relatively few examples encountered today are equipped with a heavy flywheel. That said, the checked weight of 157 gm for the illustrated aero example is only 12 gm more than the weight of the 2.5 cc aero model.

The retail price of this engine was set at 54 kr. However, it does not seem to have attracted much customer interest, since only around 300 examples were reportedly produced. Manufacture seems to have ended in 1951 after only a year or so. Consequently, it is a very rare engine today.

Claimed output of this model was 0.20 BHP @ 8,000 rpm. If true, the engine delivered a power-to-weight ratio that was well in excess of that developed by the 2.5 cc version. It also peaked at a considerably higher speed.

Viking 3.2 glow – 1952-1954

Viking 3.2 cc glow-plug model

This design represented Clausen's first step towards the modernization of the Viking range. It was a graceful glow-plug motor of basically up-to-date design featuring rear disc valve induction and reverse-flow scavenging. It retained the unusual forward-facing exhaust port location which had characterized the earlier diesel models, but took practical advantage of the absence of the sideport induction tube by adding a second matching exhaust port at the rear.

Both exhaust ports were unusually large.

As with the earlier diesel models, twin bypass/transfer ducts were provided, one on each side. In effect, this was the familiar Cox-style four-port scavenging system.

A quality touch was the design of the needle valve assembly, which followed the established "racing engine" pattern by using separate screw-in needle carrier and fuel jet components with an externally-threaded needle. Tension was provided by a split in the needle carrier which in turn was tensioned by a knurled gland thimble. Both elegant and effective!

Bore and stroke of this unit were 16.0 mm each for a displacement of 3.22 cc. The engine weighed a claimed 150 gm - near enough to my own example, which checks out at 154 gm

(5.43 ounces) with plug. An output of 0.25 BHP @ 12,000 rpm was cited by the manufacturer. The engine was offered for sale at a price of 79 kr.

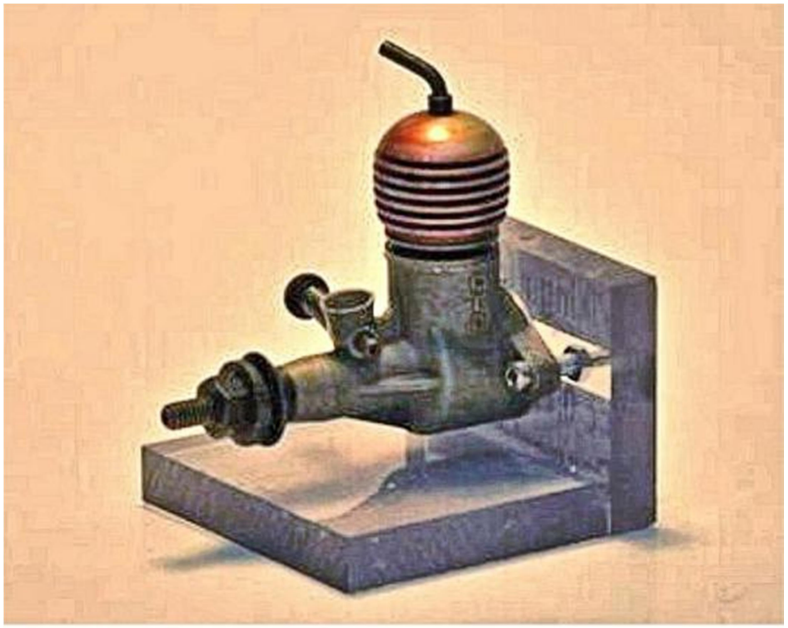
Unfortunately there were some design flaws, in fact a characteristic problem with all of the Viking engines. As a result of these issues, the engine did not succeed in penetrating the marketplace. It appears that only some 100 examples were manufactured in total, making this an extremely rare and highly sought-after engine today.

Viking 0.75 Red Helm (Red Head) diesel – January 1955 – 1963?

This is more or less a direct copy of the 1953 McCoy “Durango” .049 diesel. The Viking Red Helm (Red Head) version differs in detail from the McCoy original, having amended bore and stroke measurements of 10.2 mm and 9.1 mm respectively for a slightly reduced displacement of 0.744 cc. This was likely due to the possibility which existed at the time (but never actually became reality) of the FAI introducing a new competition class for engines of up to 0.75 cc.

The Red Helm weighed in at 42 gm. The manufacturer made no specific power output claim for this model, instead contenting himself with stating that peak power was delivered at 14,000 rpm. The engine sold at a retail price of 54 kr.

Unfortunately, this model too suffered from a serious design defect. Wishing to avoid the use of the McCoy’s O-ring contra-piston, Clausen elected instead to use a steel contra piston which was stamped from steel plate. This component frequently leaked quite badly, as a result of which the Red Helm quickly acquired a rather poor reputation among modellers due to the starting difficulties which often resulted from this leakage. Small diesels are hard enough to start on high-speed props without a handicap of this sort!



Viking “Red Helm” 0.75 cc diesel (Luis Petersen)

Production typically averaged only some 25 units in three weeks, and at times it was much less. During the engine’s relatively long production life extending from January 1955 to around 1963, only about 2,000 examples were reportedly made in total, presumably in small intermittent batches as dictated by demand.

Viking 2.48 Super diesel – 1956-1963?

In 1956, Clausen introduced a 2.49 cc model called the Viking 2.48 cc Super which was in effect an enlarged version (without the red head) of the Red Helm 0.75 cc design which had been introduced in January of the previous year. The engine actually bore a marked similarity to the contemporary Webra engines from Germany.

Bore and stroke of this model were 14.55 mm and 15.0 mm respectively for an actual displacement of 2.49 cc. The engine weighed a commendably light 118 gm (4.16 ounces), although this low weight was achieved at the expense of a certain fragility. Claimed output was 0.24 BHP @ 14,000 rpm. The engine sold for a retail price of 69 kr.

Unfortunately, this model perpetuated some of the design flaws of other Viking models, notably the Red Helm. The contra piston followed the same pattern by being formed as a steel stamping. This component was prone to leakage, just as it had been with the smaller model. Later examples had turned and lapped contra pistons to deal with this issue. However, the engine's overall construction was too light for adequate distortion resistance and durability. The original crankshafts manufactured by Clausen proved to be somewhat undependable, but durability was later improved through the use of forged shafts which were produced elsewhere by a sub-contractor.

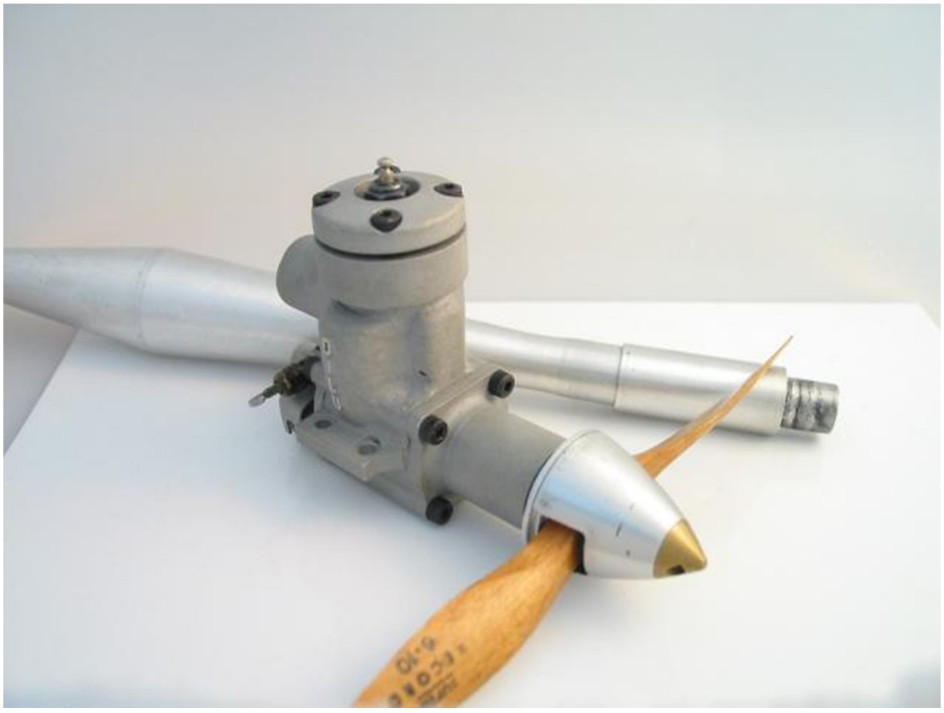
Viking "2.48 Super" diesel

Production of this model typically averaged around 25 units in two weeks. A total of about 3000 units were reportedly manufactured in total.

If Clausen had been able to shake off a few design tendencies such as the application of excessively light and over-simplified construction plus the use of excessively heavy pistons, the range might well have fared better in the long run. However, that was not to be. Regardless, the Viking venture has left us with a number of highly serviceable engines which careful owners can still enjoy today.

The availability of cheap high performance foreign engines soon stopped all production of Danish model engines. Only a few special competitions engines were made by individual persons. Mostly in the controlline classes.

At the control line World Championship in 1966 a totally new speed engine won the contest. Bill Wiesnevski, the designer made a speech explaining all the secrets of the design, with its resonance pipe, it gave a performance increase of 30%.



The TWA engine was not for sale. So Dirch Ehlers and I started making our own engine based on all his information.

For the WC in 1968 our engine DILU was ready in both Diesel and glow versions.

High power, but little training gave poor results. Compared to the new Italian Rossi Normale, the glow had an equal performance.

Specielt i linestyrings konkurrenceklasserne blev der lavet mange enkeltstyk motorer, tunede udgaver af de bedste motorer, men en reel rentabel produktion var der ikke tale om.

Lupe engines.

After the DILU engines, Luis Petersen made a number of oneoffs T/R engines. In connection with his engineering studies, the production documentation for a 2,5 cc. T/R engine was made in 1972 along with 10 crankcase castings for a Lupe Mk.II.

I Modelflyve Nyt 1983-84 blev tegningerne bragt som et selvbygger project, hvor man kunne købe krumtaphus støbninger. Det var også muligt at købe en færdig krumtapaksel, hvis man havde et problem med fremstillingen.

The Hasling engines.

At the WC 1966 in England it was not only in speed that there were new engine designs. Paul Bugl showed his HP15 Schnuerle ported


team race engine in Team Race.

For several years this was the higest performing TR diesel engine. Bt with a very limited production number. So a Dane, Ole Hasling started making a HP copy. Unfortunately he did not have enough time/money to get into a real production, although the preproduction run showed promise of a very potent engine.

BG motorerne.

The Austrian Paul Bugl continued his design of diesel engines and introduced his PB15 diesel in 1973. Except for some special Russian engines, this was the engine to beat.

This writer took over the global repair business of the Bugl engines

When he died in 1978 Hans and Jens Geschwendtner bought the shop and moved production to Copenhagen. His newest design Mk.III was not really an improvement on the previous. So the his design was upgraded and sold as the BG Mk.I

The engine won the World Championship in 1980. After a couple of years, the production stopped. ~ 200 being produced of the Mk.I

A new lighter higher performance design BG Mk. II AAC was developed and produced in limited numbers ~10 for personal use.

The pictures below is to my knowledge the last production engine made in Denmark.

Luis Petersen/Adrian Duncan