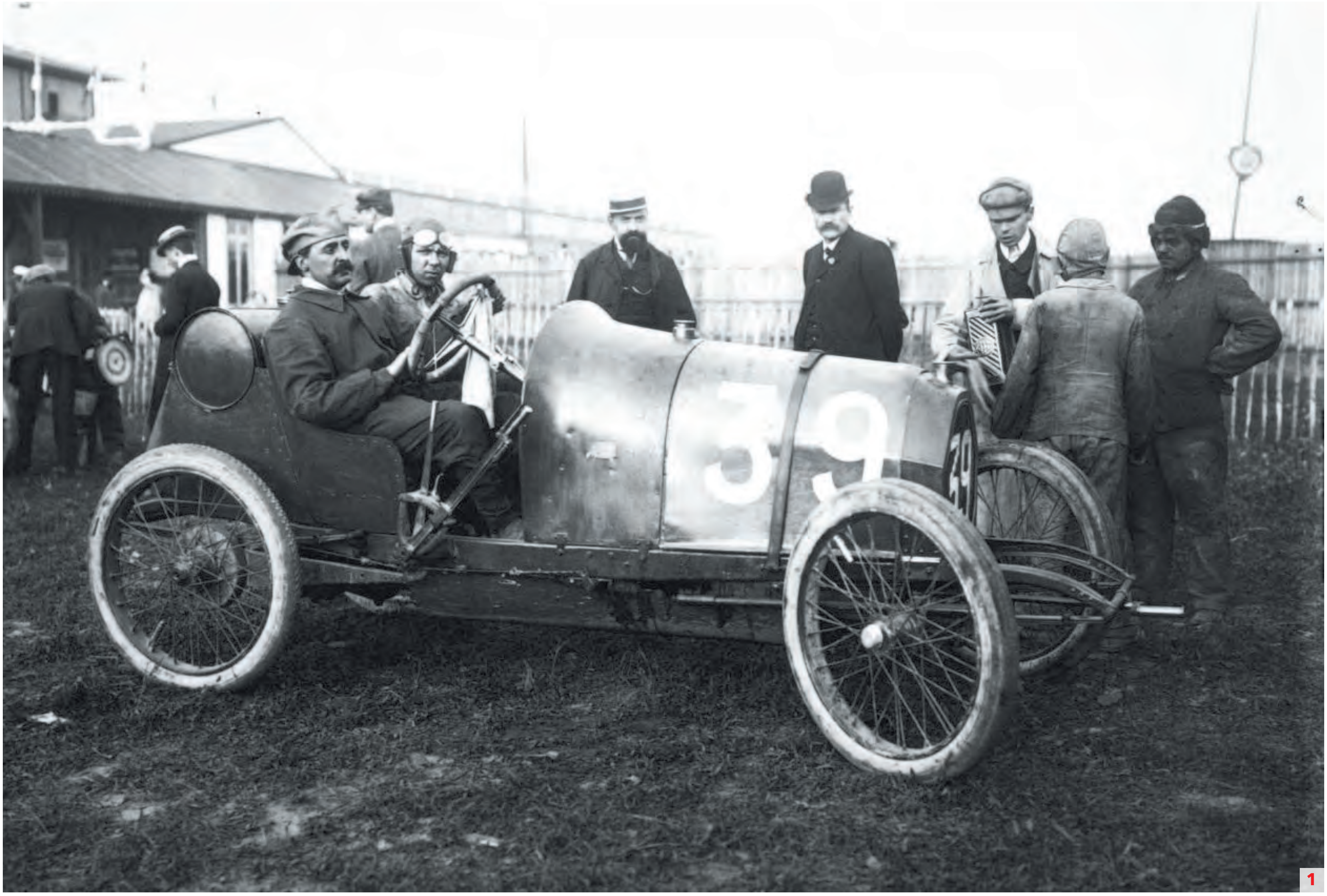

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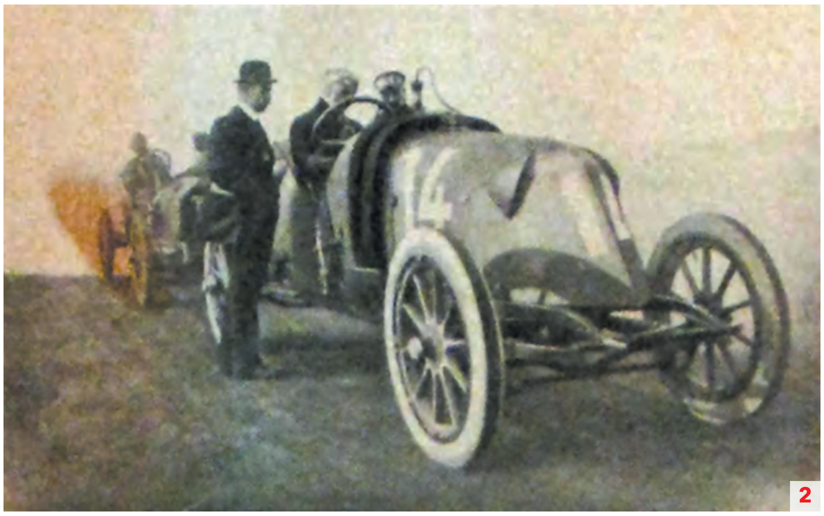
1908 ARIÈS

THE FIRST HIGH-PERFOMANCE DESMODROMIC ENGINE

The recent discovery of a pre-WW1 racing engine means the history books need to be rewritten. **Sébastien Faurès Fustel de Coulanges** and **Henk Cloosterman** present the results of their Franco-Dutch investigation



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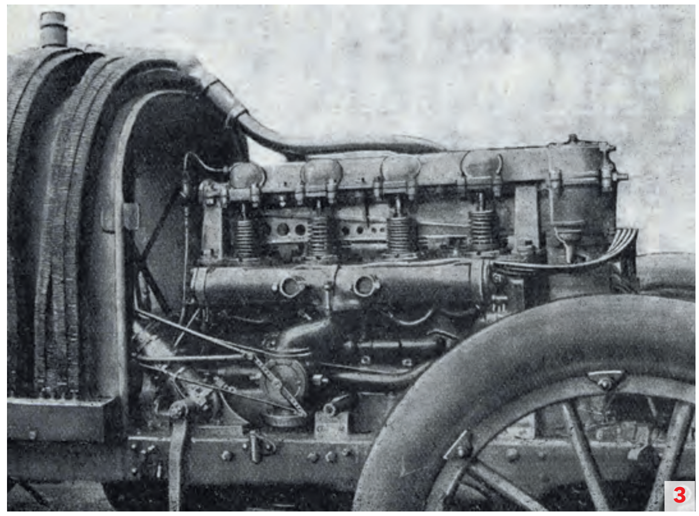

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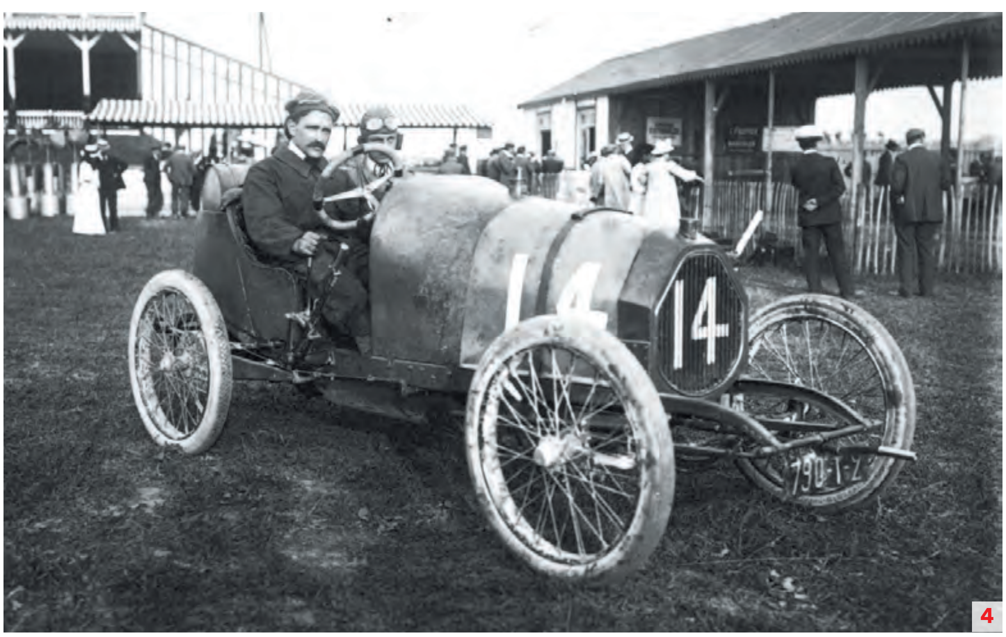
For several decades it was generally considered that the world's first desmodromic engine was the 1912 dohc Peugeot L76. Then in 1986, in Volume 24 Number 3 of *Automobile Quarterly*, Griffith Borgeson published a detailed article about the 1914 Delage Type S. More than just the story of a famous racing car, it was in fact an in-depth investigation about the misinformation through motor racing history that had misled people to attribute to the Peugeot some technical features which in reality only materialised two years later on the Delage. And Borgeson concluded his article in the following way: 'The priority of Michelat and Delage in the successful application of the desmodromic principle to the modern breed of high performance engine is unchallenged.'

So since 1986 it was considered as a fact that the first 'identified' desmo engine was the 1914 Delage Type S. Then an additional step was made with the publication of our article about Gratien Michaux in the February, 2012, issue of *The Automobile*. In this study, while we followed Borgeson's conclusion regarding the priority of Delage for the first desmo engine, we nevertheless fine-tuned it by adding that in 1914 the Delage was not the only desmo engine as there had also been the Th Schneider Type 15000. And more importantly, thanks to patent investigation, we revealed that it was the same designer who had designed the desmo principles of both cars: it was not Léon Michelat but Gratien Michaux. So we concluded: 'As a summary, one will remember the following milestones from Gratien Michaux…1914 – Key-pioneer in effective desmodromic distribution.' But what is nice with historical research is that it is never finished. You never know if someday a new discovery will make an earlier conclusion obsolete. That is precisely the case here. Our conclusion about Gratien Michaux is no longer applicable because of a newcomer in the story: Ariès.

The Société des Automobiles Ariès had been created in Villeneuve-la-Garenne in 1903 by Baron Charles Petiet. Production began with cars powered by two- and four-cylinder proprietary engines from Aster. A milestone was reached in 1907 with the début of Ariès's first purpose-built racing car, the Type CE, designed for the Kaiserpreis. The CE was an outstanding design, powered by an over-square sohc four-cylinder engine of 7.9 litres (160 by 98mm), delivering 78hp. Unfortunately it was not very successful. Both examples failed to appear at the Kaiserpreis on 13-14th June, 1907 (Léon Collinet – no 25A, Jean Vallee – no 25B), and at the Circuit des Ardennes on 25th July they both retired early in the race (Jean Vallee – no 4, A Villemain – no 14)

These poor results would not prevent Ariès from offering the CE to the public in its 1909 range, but for the 1908 season the company decided to re-orientate its racing strategy. With manufacturers such as Sizaire et Naudin and Lion (the 'other' Peugeot company), the voiturette category was then becoming more and more popular for a fraction of the cost of the Grand Prix category. Therefore Ariès launched a factory team of voiturettes for 1908: three Type VTs, powered by a purpose-built racing single-cylinder of 1.4 litres (100 by 180mm) delivering 16.5hp at 1800rpm. What is unknown is if these engines were still proprietary units from Aster or if they were Ariès's own designs. Anyway, the VT did not perform much better than the CE. In the Grand Prix des Voiturettes on 6th July, 1908, of the three VTs (Perrot – no 14, Meaux de St Marc – no 39, and Richez – no 57) only Perrot and Richez really took part in the race



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1 Meaux de St Marc at the wheel of the Ariès VT before the Grand Prix des Voiturettes on 6th July, 1908. This is possibly the car with the engine featured in this article; it powered only one of the three-car Ariès team, but no external clue confirms its identification (*BNF*)

2 A Villemain at the wheel of the Ariès CE at the Circuit des Ardennes on 25th July, 1907. It was the first purpose-built Ariès racing car. Note the rear radiator and the V-shape bonnet (*SFFC*)

3 The 1907 Ariès CE racing engine. An oversquare four-cylinder of 7.9 litres (160 by 98mm) delivering 78hp, it was one of the very first sohc racing engines, preceding the 1908 Clément-Bayard and Weigel (*SFFC*)

4 Perrot at the wheel of the Ariès VT before the Grand Prix des Voiturettes on 6th July, 1908. Like Meaux de St Marc's car shown at the beginning of this article, it is not possible to confirm if its bonnet conceals 'our' engine. (*BNF*)

5 The 1908 Ariès VT engine, as it came to light during an auction in 2014, after more than a century of oblivion. It is a single-cylinder of 1.4 litres (100 by 180mm), delivering 16.5hp at 1800rpm. It was outstanding for its time, if only for the sohc and four-valve configuration. But in fact it features far more than this… (*Yesterdays*)

6 With the camshaft cover removed, one can see the bevel-gear driven by the vertical shaft and the fact that the valves are paired (*Yesterdays*)

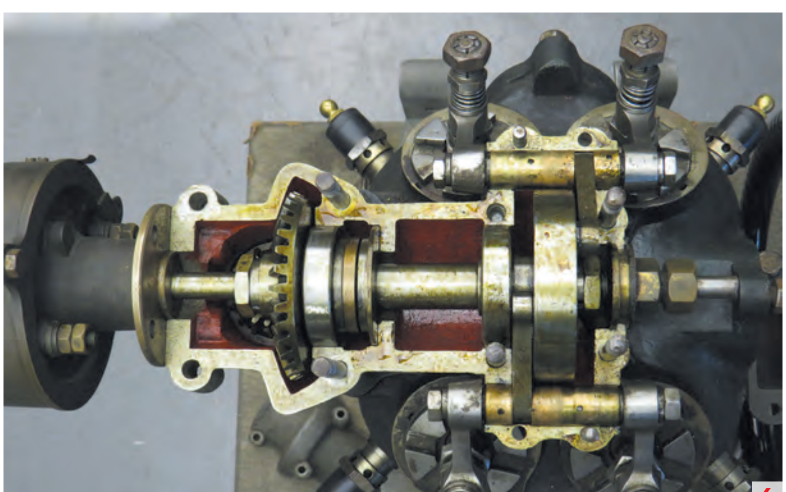
7 And at last, the evidence awaited for so long: desmodromic distribution, via a single pen in a cam-shape groove. This is what gives this engine such historical significance: for now, this is the oldest identified high performance engine with desmodromic valvegear (*Yesterdays*)

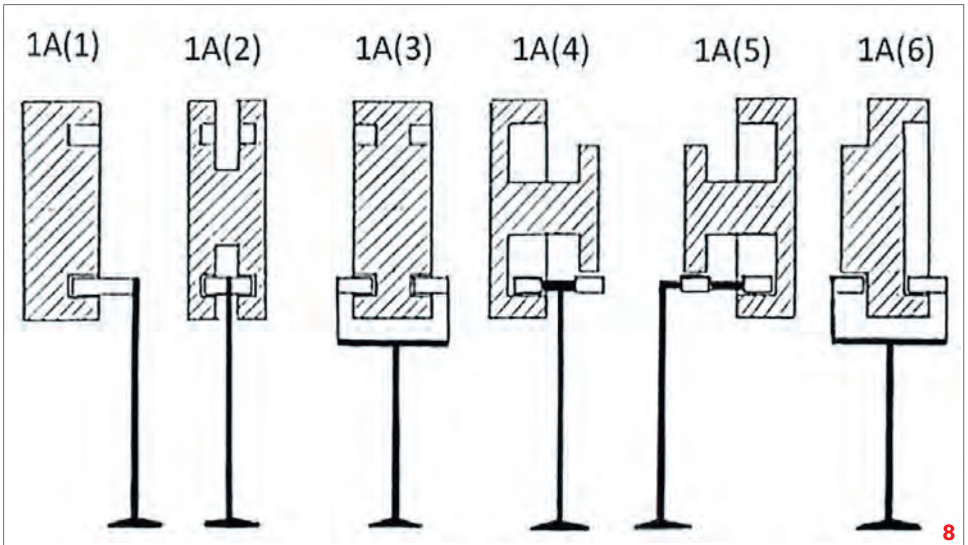
but they did not go further than a single lap. The results at the Coupe de Normandie on 15th August were slightly better, with Meaux de St Marc finishing third on car no 3, but it was most probably a Type V instead of a Type VT, powered by a sidevalve narrow V-4 engine of 1.1 litres (60 by 100mm), as the 1909 catalogue would state 'Coupe de Normandie: 1st prize of the 4-cylinders.' Lastly, in the Coupe des Voiturettes on 27th September Meaux de St Marc finished 15th on car no 29, while both Vallee and Perrot had retired on cars no 9 and 21. After these disappointing results, Ariès ended its involvement in racing. One would have to wait until 1923 to see the marque racing again, with Hispano-inspired sohc three-litre touring cars, but that is another story. Let's return to the voiturettes.

Like the CE in 1909, in 1910 the V would become part of the catalogued range of Ariès. But nothing more was heard of the VT. The only time some technical details were provided about it was in the 25th November, 1921, issue of *La Vie Automobile*, which included a letter from Baron Petiet. After having described the CE, Petiet stated: 'We also used the overhead camshaft arrangement on one of the single-cylinder voiturettes that we had built for the 1908 Grand Prix des Voiturettes. This voiturette included the following features: four valves per cylinder, with desmodromic drive and an overhead camshaft; intake with compressed gas at a higher pressure than atmospheric pressure; lower end stroke exhaust via a specific valve; ignition with four spark plugs per cylinder.' When one reads this description, it simply seems impossible that such an engine existed in 1908, and one wonders if Petiet had not mixed his wishes, his experiences and his dreams with what Ariès had actually manufactured. In any case, as no picture of this engine seemed to exist, without any further evidence we did not consider Petiet's words seriously and we disregarded Ariès in the history of desmodromic engines.

However, six months ago, on 6th December 2014, our friend Peter Jacobs from the Delage Register sent us an email, informing us that an interesting single-cylinder engine was for sale in The Netherlands. Peter wondered if it could be Némorin Causan's long-disappeared Delage single-cylinder ZC, which won the 1908 Grand Prix des Voiturettes. When looking at the pictures, at first sight the engine did not remind us of any of Causan's subsequent designs, such as the 1912 Sizaine et Naudin or his 1913-14 legacy of racing boat engines. Considering the other sophisticated racing single-cylinders of the same period, we also quickly eliminated Louis Verdet's 1909 Lion-Peugeot, which had six horizontal valves (see *The Automobile*, May, 2012). What remained was the 1908 Ariès. Comparing the pictures to Petiet's description, all the features matched…

Our curiosity was so piqued about the possible historical significance of the engine that we decided it was worth a trip to the vendor. Yesterdays (www.yesterdays.nl) has been selling antique and classic motorcycles for 35 years and is run by Thijs Lempens and Geert Verslijen. They informed us that the engine had been initially sold by auction by Osenat in 2014, on behalf of a member of Baron Petiet's family. Therefore any niggling doubts about the identity of the engine, if any, were laid to rest. The engine seemed to have been hidden and neglected in the baron's





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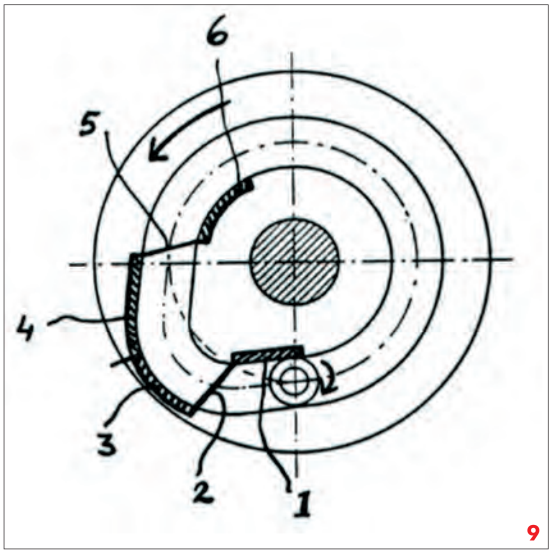

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estate for more than a century. Sadly, it is incomplete in such a way that it is difficult to believe it will ever run again. Important parts, such as both flywheels, the distributor and the carburetter, are missing. But whatever its state, we were still holding our breath thinking about the surprises its internal parts would reveal. Fortunately Thijs and Geert, who have been so helpful, were not afraid to completely dismantle the engine for us. What they discovered under the camshaft cover was indeed of historical significance: desmodromic valvegear.

The distribution is secured by four large valves, set up at a 60deg angle. Note that, as only one half of their diameter is visible from the interior of the cylinder, the combustion chamber has a larger diameter than the cylinder. The desmodromic system is a simple one: a single pen or roller in a cam-shaped groove (*coulisse*). In fact the Ariès construction looks like a bevel shaft-driven sohc with valves operated by rockers, except that the cams on the shaft are replaced by a disk with a cam-groove on each side. One cam groove drives the inlet valves, which are linked and operated by a single rocker, and the other cam groove does the same with the exhaust valves. For this purpose, the rear end of the two valve rockers features a perpendicular roller which slides into the cam groove.

It is very likely that the Ariès engineers were familiar with this kind of system, at least on a theoretical level. In the 19th century it appeared in textbooks and some patents were already granted, such as US602477 to J A Secor and US699235 to P L Hider, both in 1898. In Henry T Brown's book *Five Hundred and Seven Mechanical Movements* (1868), on fig 97 [1] we can see a desmodromic cam-groove pen (roller) shaped cam-follower system (Desmo-classification group 1A). In this group, the roller wears significantly as it is changing in direction twice during one single revolution of the cam. For this reason inventors dreamt up systems with the opening (acceleration) and closing (deceleration) cams separated from each other and with separate cam-follower portions (pen or roller). As a result, 1A group features no fewer than six different types of embodiment, the last three having, as described, separated opening and closing cams.

The Ariès features the simplest version of the group: 1A(1). In this embodiment, taking into account that the cam turns counterclockwise, the working phases are as follows:

Ph 1 - Acceleration during opening. Roller touches inner curve. Roller turns counterclockwise
Ph 2 - Free flight. Roller moves from inner cam-circumference to outer cam-circumference
Ph 3 - Deceleration during the opening phase. The valve is decelerated till max opening
Ph 4 - Acceleration during closing phase
Ph 5 - Free flight
Ph 6 - Deceleration during closing phase. Roller touches the inner cam-circumference again.

ARIÈS VT TECHNICAL SPECIFICATION

Engine type: four-stroke water-cooled single-cylinder
Displacement: 1414cc (100 by 180mm)
Distribution: shaft-driven sohc, four valves, desmodromic
Ignition: double (two contact points) coil (four spark plugs)
Blower: pre-compressed mixture entering via rotating sleeve valve
Power: 16.5hp at 1800rpm (11.8hp/l), 20hp at 2300rpm (14.3hp/l) depending preparation
Gearbox: four-speed
Wheelbase: 2250mm
Track: 1230mm
Tyres: 810 by 90
Weight: 600kg

Data from Omnia, no 131, 5th July, 1908

VALVE AND VALVE CYLINDER DIMENSIONS

To secure the valve position in the cylinder head, Ariès used complex old school valve-cylinders as seen in many water-cooled engines with integrated cylinder-head of the same period.
Valve disc diameter: 46mm
Valve stem diameter: 12mm
Valve length: 157mm
Valve cylinder diameter: 55.8mm
Valve cylinder length: 70mm
Valve lift: 8mm
The small spring visible on the picture was added to compensate closing clearances and for providing compression during cold starts of the engine.


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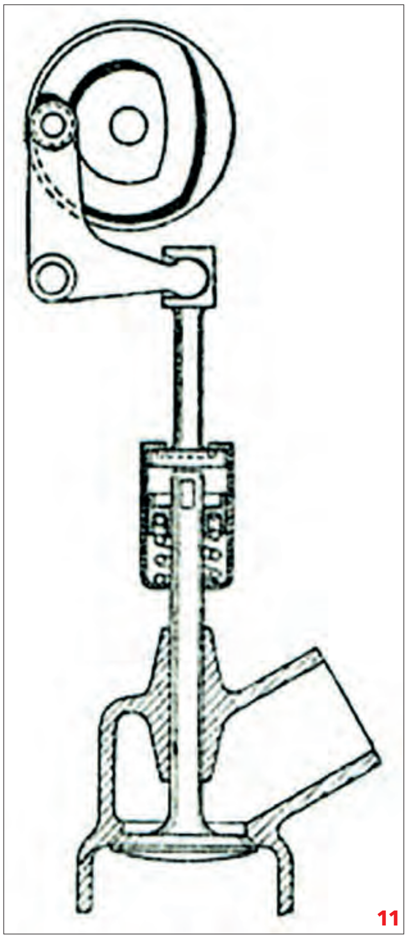
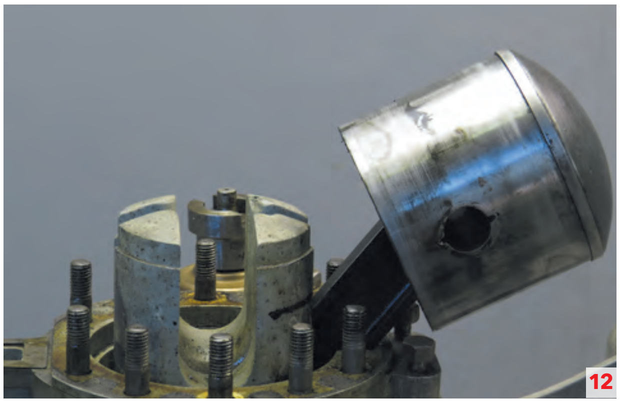
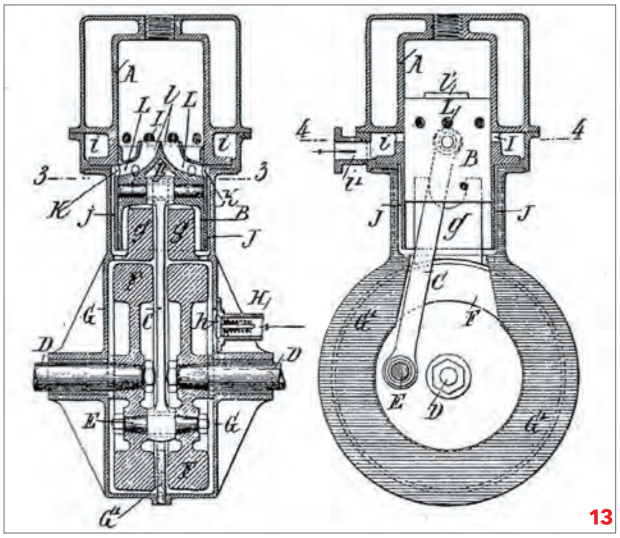
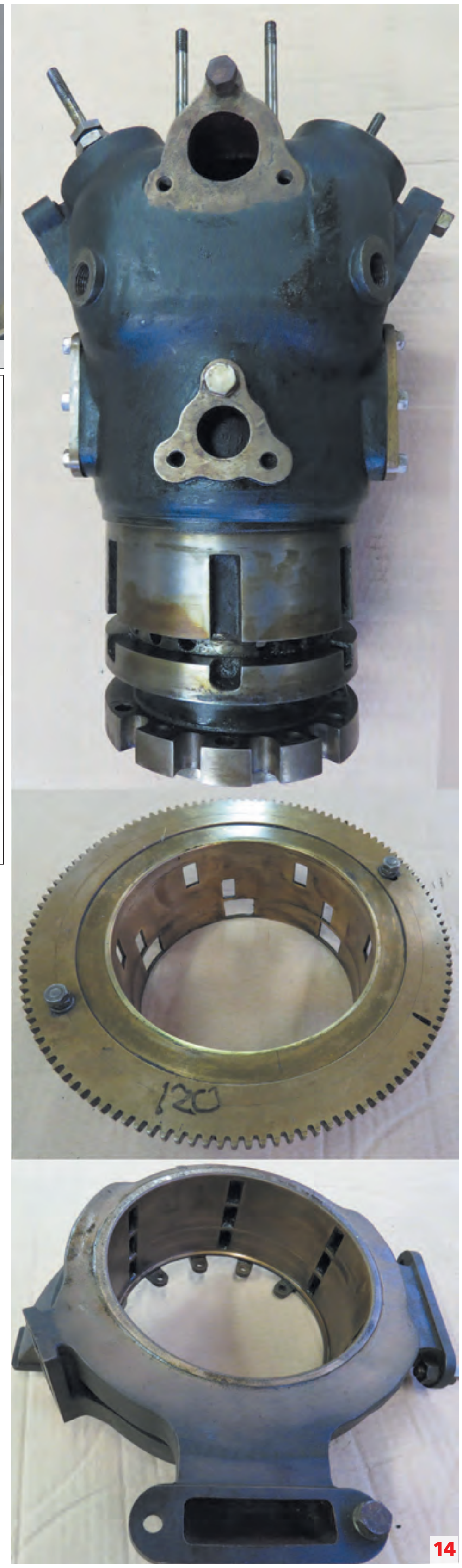
8 Desmodromic system principles with cam-groove pen-shaped cam-follower (Desmo-classification group 1A) are in fact quite old, as shown on Fig 97 [1] illustrated in Henry T Brown's *Five Hundred and Seven Mechanical Movements*, dated 1868. The Ariès features the simplest version of the group: 1A(1) (*H Cloosterman*)

9 The working phases of the desmodromic system of the Ariès VT (*H Cloosterman*)









11 Frank Hadfield Arnott's 1910 desmodromic principle as illustrated in Alan Baker's article More About Desmodromics, published in 1956, and presented as the 'father' of the desmodromic saga. For nearly 60 years historians would rely on this information as a proven fact, while the Ariès preceded it by two years (*H Cloosterman*)

12 Another outstanding feature of the Ariès VT: a supercharging system. Here one can see the lump of metal located under the piston. When the piston goes down, the air under the piston is compressed and then pushed through timed holes to go to the carburetter (*Yesterdays*)

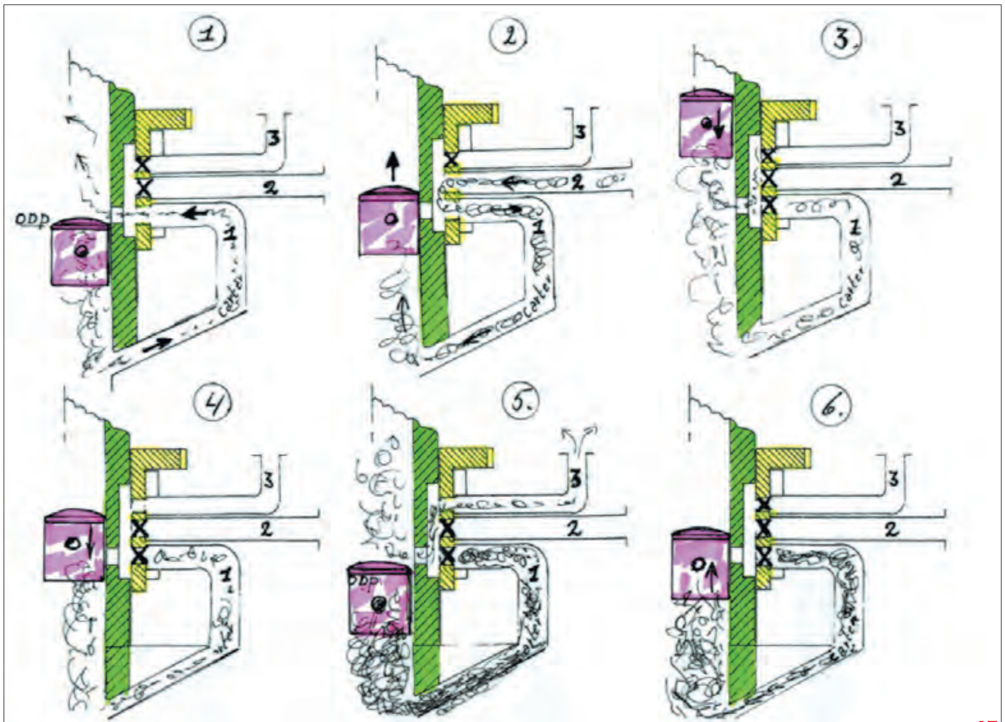
13 Illustrations of Lefebvre's 1902 patent, ref FR322897. Its supercharging system is more simple than the Ariès as it is intended for two-stroke engines, but there is clearly a family link revealed by the lump of metal which has exactly the same shape as the Ariès released six years later

14 The main elements for the timing dedicated to the supercharging and scavenging systems: the cylinder, the rotating steel ring driven by a milled gear in the bevel-shaft, and then the fixed outer ring (*Yesterdays*)

In the 19th January, 1956, edition of *The Motor Cycle*, Alan Baker published an article titled More About Desmodromics where he stated: 'All the activity in the 1920s might suggest that, apart from Delage (note: 1914) and Brewster (note: 1916), no one did anything earlier on positive closure. However, that was not the case, because as far back as 1910 Frank Hadfield Arnott provisionally patented the granddaddy of the desmodromic valvegears. The Arnott design employed a cam track and a bell-crank lever, also a small clearance between the cam follower and valve, and a closing spring – the ingredients subsequently utilised in varying degrees by later designers.' As this article was one of the first serious investigations into the history of desmodromic engines, it was to have major influence in all subsequent works on the subject. Consequently, while it is, up to now, considered as a fact that the first desmo engines were built in 1914, the beginning of the desmo story is nevertheless regularly credited to Arnott's patent, Arnott being himself considered as the father of desmodromology. However, firstly the patent had never been granted to Arnott: in 1987, in the frame of our own investigations, The Patent Office confirmed that Arnott had applied for a patent in 1910 but that the application had been abandoned before publication. Secondly, based on available drawings, Arnott's 'invention' is simply a duplicate of the principle applied on the Ariès two years earlier. As a result, until any further discovery (and to re-use some of Borgeson's own words): the priority of Ariès in the design and construction of desmo engines is unchallenged.

But as described in Baron Petiet's letter, the desmodromic distribution was not the only outstanding feature of the Ariès engine. A supercharging system on a 1908 car is worth more than a few words. In the carter is a lump of metal which fits exactly under the piston. In that lump one can see two milled cross-sections: one smaller arm for the connecting rod and one broader arm for the piston pin. When the piston goes down, the air under the piston is pressed into the small carter. This air is pushed further through timed holes and builds up a pressure higher than the atmospheric pressure, when going to the carburetter (2), above the piston (1) and for better scavenging (3). Compressing air in this way had already been patented six years before, by a certain Mr Lefebvre in July, 1902 (ref FR322897). But while the shape of the lump in the Ariès engine matches the patent perfectly, the scope of the latter was limited to two-stroke engines.

In addition the Ariès has an even more sophisticated and complicated timing, as illustrated and explained in the 12 pictures



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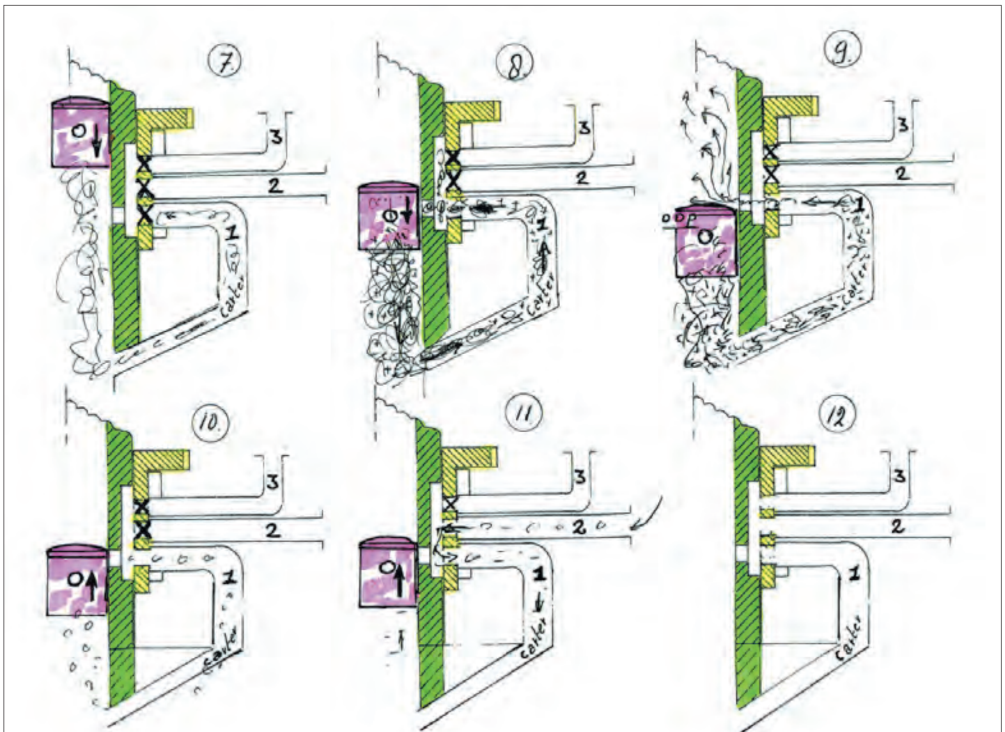
15 Theo van Nieuwenhoven, the mechanic at Yesterdays, has made some drawings which show in detail the working phases of the supercharging and scavenging timing: the corresponding ports in the rotating ring/sleeve are S1, S2 and S3, and the angular rotation of the crankshaft is measured from BDC (bottom dead centre). Fig 1: Start position, 0deg BDC, S1 is open. In this specific position there is a connection between the carter-space and the space above the piston via the holes in the cylinder. The pressure above and under the piston is the same. Fig 2: With the piston going upwards, firstly the cylinder holes are obstructed, at 45deg S2 is disclosed, while S1 was already open. At 90deg the piston skirt discloses the cylinder holes. This is not yet influencing the process. The carter will now be sucked-in completely full, this is something after TDC (at 215deg), because at this point S1 and S2 are closing simultaneously. Fig 3: When the piston goes down again, the carter will be compressed because all sleeves are closed (between 215 and 260deg). Fig 4: At position 280deg the cylinder holes close and S3 opens. This does not affect yet the compression process. Fig 5: At 335deg (almost BDC), when the piston crown discloses the cylinder holes, the compressed air cannot flow above the piston because S1 is closed. In this situation S3 is still open and so a connection with the cylinder-space is established. That means that the residual pressure of the combustion that took place above the piston can escape via S3. Fig 6: During the upward travel of the piston at position 450deg firstly the cylinder holes are obstructed together with S3. The fully filled and pressurized carter will help the piston in his upwards stroke (*Yesterdays*)



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16 Fig 7: With the piston descending again the pressure is built up as well. Fig 8: At position 630deg S1 opens, but because S2 and S3 are closed, the pressure will be rising for some time. Fig 9: Till position 720deg when the cylinder holes are disclosed again, the pressure via S1 and the cylinder holes can flow above the piston, S2 is still closed at that moment. The whole process can continue / start again. Fig 10: In this position, shortly after BDC the carter is closed again. Fig 11: The situation when S2 is about to open again. Conclusion: when S3 is open, it is only possible for a short period of time to communicate with the cylinder space, only when the cylinder holes are disclosed. We also see that S2 cannot be opened alone, but always together with S1. The sucked-in amount of air (mixture) fig 3 is not brought above the piston immediately at the first passage of the BDC (fig 5), but only after the next passage (fig 9). At passage fig 5 we see that above the piston it is the beginning of the exhaust stroke of the four-stroke cycle. One could imagine that at this moment exhaust gases could escape or even air could be blown in (*Yesterdays*)

showing the different phases of the process. It is accomplished by two steel rings: a fixed hollow ring-like body and a rotating one driven by a milled gear in the bevel-shaft. The driven ring (yellow) rotates around the cylinder (green) and inside the outer ring (consisting of the three canals). In the cylinder wall itself there is at a certain point also a ring of holes of importance in the process.

Unfortunately the engineer who designed this engine has never been identified. By the way, a hint of mystery surrounds the design office of Ariès as we have not been able to identify any chief engineer of this marque, except Léon Michelat, the Delage man, who held this position for a short period from 1st November, 1924, to 1st June, 1925, and Émile Petit, the Salmson man, from 1929 to 1931. Maybe Mr Lefebvre, author of the 1902 compressed air patent, could be a clue? It's a pity as, thanks to the desmo principle, the sohc combined with four valves (which to our knowledge is also a world first), the supercharging system and the four spark plugs, when it was released and even for several years afterwards, the Ariès VT was simply the most sophisticated racing engine in existence.

FURTHER READING

Alan Baker, More About Desmodromics, *The Motor Cycle*, 19th January, 1956
Henry T Brown, *Five Hundred and Seven Mechanical Movements*, 20th edition, 1903
Henk Cloosterman, *Desmodromie: Totaaloverzicht van honderd jaar desmodromische klepbediening in interne verbrandingsmotoren cop.*, 1990
Jean Sauvy, *Les Automobiles Ariès*, Presses de l'Ecole Nationale des Ponts et Chaussées, 1996 (note: this is for the Ariès context; it does not include any desmo detail)
Philip H Smith, *Valve mechanisms for high-speed engines: Their design and development*, second edition revised by L J K Setright, 1971

MORE ON DESMODROMICS

Should any reader be interested in the principles of desmodromic distribution, then a visit to Henk's website www.desmodromology.nl is a must. ■