

Wing systems in the Netherlands

Original the Dutch mills had only cloth sails and the very early mills had double framed sails. Later the old-dutch wingsystems (common sails) came, which most mills in the Netherlands have today. Till 1891 nothing happened but than came the first improvement with the patent sails.

The patent sail system

In 1891, the very first system of patent sails in the Netherlands came from Germany and was built on the **Eva** in Usquert, in the province of Groningen. The owner-miller, mr. K.E. Welt saw the system on a industrial exhibition in Schönebeek, Germany and he wanted to have the most modern mill of that time. The Eva was just being rebuilt by millwright Christiaan Bremer after the fire of the old mill on the 29th of December 1890. The mill was also fitted with selfwinding with a fantail. The tailbeam was left because the miller did not like a mill without a tailbeam. The result was, that one day the mill stood 90 degrees wrong and the fantail was blown off!! The reason was clear: the miller had fastened the tailbeam like he always did before! The tailbeam was taken away after this happening.....

The patent sail system was mainly used in the northern provinces of the Netherlands, and also nowadays the system is most seen in the provinces Groningen, Friesland and Drenthe. In total there are 57 mills with patentsails left in the Netherlands including 40 in the province of Groningen.

The origin of the patent sails lies in the United Kingdom, where the development of the system ended with the patent sail system by William Cubitt in 1807. A lot of mills in the UK were already replaced by steam- and petrol engines around 1900. But in the Netherlands the last innovation of wingsystems took place between 1920 and 1940 and just after the Second World War. There were in the sixties still mills in full use! Even now there are some mills (corn and polder) professionally used. It is also the reason, that the profession of millwrighting is still alive in the Netherlands. There are still enough millwrights to maintain all of the 1100 mills today.

The innovation after 1900

The aircraft engineer **A.G. von Baumhauer** from Delft, was very interested in mills as machines. He invented a new wing system which he patented in 1922. The system is never used on a mill.

In 1923 the “**Hollandse Molen**” was founded to protect mills and in 1924 they hold a contest to stimulate wing improvements.

The Dekker system

Millwright A.J. Dekker from Leiden invented not alone wing improvements but also a rollerbearing for the windshaft and screwpumps in stead of archimedian screws or scoop wheels.

The contest commission of Hollandse Molen with chairman ir. H. Wortman advised to develop the systems of Dekker further. This was realized in 1926/27. The mill where it was

tested was the poldermill in Waardenburg in the polder the Tielerwaard. There were great expectations of the system, because tests in the Laboratory for Aircraft Studies pointed out, that the efficiency factor of the old-dutch system was only 9-12% and the new system was calculated at 34-52% !

After the whole of Dekker-improvements was realized, there was a test on the 29th of November 1927 with was also attended by the Minister of Waterstaatzaken. The test was successful and the Minister wrote to all polder-authorities the benefits of the system. The system spread rapidly in the years 1928, 1929 and 1930. In 1930, 31 mills already got the system! Mr. Dekker got a patent in 1929 with the number 24753. In the first 5 year the system was used on poldermills only. Afterwards also corn mills were fitted with the system. Between 1927 and 1933 83 mills were fitted with the Dekker-system.

The Dekker system is an aero-dynamic cladding on the leading and trailing side of the stock. The cladding is made of zinc, galvanized steel plate or aluminium. The advantage of aluminium was that it was about 250 kilogram lighter than zinc.

Because of the torque at low speed and braking, Dekker added airbrakes in each end. He also altered the camber of the sailbars to nearly zero because of the flapping of the sails. The problem of the flapping was never loosed in spite of making the sails even smaller.

Except the well known Dekker-wing, Dekker experimented also with his "halfverdekkerd" or "spleetwiek". It looked like the Fauel-system mounted behind the windboards and Dekker got troubles with the patent of Fauël, who brought this in court. Dekker lost and had to stop with the system of half-Dekker or spleetwiek.

The Prinsenmolenwiek

In 1935 the polder authority of the Hoogheemraaschap Schieland took a decision to search for better performance of poldermills. The Prinsenmolen at Hillegersberg was the mill where the try outs took place. The Prinsenmolencommissie consisted of Ir. Wouter Cool, chairman, J.J. Hillen, secretary and the members dr. J.M. Burgers, ir. A. Havinga, ir. J. Muysken, ir. W.H. van Nootenvisser. Very important was ir. Havinga, who did the investigations and experiments. The Hoogheemraadschap had also the idea to share the results with other polder authorities in the country. First they made a null measurement in 1936. Then the scoop wheel and the gear reduction were altered to make the mill earlier starting and making so more pumping hours. In a windtunnel there were tests for Dekker and Bilau. From the Dekker profiles Havinga tested so long till he had the best results. This profile was patented as number 45827 and was used as base for the improvements at the Prinsenmolen. During 1938 all was worked out, tested and built on the mill. The test pumping took place on the 8th of June 1938. The first results looked good, but further testing pointed out, that at higher wind speeds a lot of reefing was necessary.

The Prinsenmolenwing-profile alone was not able to get the power of the old-dutch system. The disadvantage is because of the round profile at the front side. The wind cannot catch this profile good enough to make power. During windtunnel experiments the trailing sides of the wings were with cloth and the disadvantages were not discovered. One was too much concentrated on making an ideal profile and this was really successful. Practice in this case proved to be different from theory. The profile in combination with cloth was successful, but without cloth Dekker and Van Bussel were better. They made a profile what could drive a mill in all situations and windspeed. Also sailflapping occurred. This problem was faced by making the cloth less wider, but the cloth wide of a wing of 28 meter is normally 190 cm and at the Prinsenmolenwiek only 130 cm!

The whole was not a success also because of the popularity of Dekker and Van Bussel systems which were better and cheaper. Also the beginning of the World War 2 was not good for introduction.....

The whole frontside of the profile was hinged and could be open for maintenance of the stock and sail bars.

A lot of mill experts found it a pity that no practical experts were in the committee. In that case there was surely a totally other wingprofile made.

So far the history of the Prinsenmolenwiek also called the Havinga wiek. But ir. Havinga himself was always against that name. The wing is only used on the Prinsenmolen.

The Van Bussel system

Chris van Bussel, millwright from Weert, province of Limburg, was before 1934 already licence-holder of the Dekker-system for the provinces Brabant and Limburg and also for the Belgium provinces Limburg and Antwerpen.

The strong sailflapping and the nearly zero camber of the sailbars of the Dekker system were the disadvantages of that system. The low camber was the reason that the mill started bad, and with grinding with full sails developed an instable speed. These facts which throw away the advantages of the Dekker system, did Van Bussel thinking. So he invented a better Dekker system, which a rounder nose profile and a wider backside of the profile, which caused the sails lesser flapping and also the camber could be made more normal. In 1936 Van Bussel tried this out already on the cornmill in Borkel and Schaft.

Very remarkable is the fact, that the "Prinsenmolencommissie" in 1949-1941 with the Dekker system in mind, held a lot of windtunnel-experiments to come to a profile in a theoretical way, also with a round nose and a wide backside. Without the knowledge of the similar profile that Van Bussel made 4 years earlier pure on his intuitive feeling! The Borkel version proved to be much better than the "Prinsenmolenwing". Van Bussel called this a "spoonform". The Borkel system, also better than the Dekkerwing, did not satisfy Van Bussel. The cladding around the stock was too big and there were two sets of moulds needed. It took a lot of galvanized sheet metal, the wing got too heavy and last but not least: it cost too much. Before the Borkel-system Van Bussel tried out an own system which was placed on a mill of his brother, the Belgium mill in Eelen, in 1934. There were experiments for 2 years. It was from this form and not from the Borkel-profile, that the nowadays well known Van Bussel profile was born, with which hundreds of mills were equipped. By other millwrights like Bremer in the province of Groningen it was combined with patent sails. The system inspired others like Ten Have. The Ten Have system has not a name who remembers Van Bussel, but the streamline nose of Ten Have is nearly the same as Van Bussel. It is only somewhat wider and sharper.

The great advantages of the system Van Bussel were:

- 1 There was about 60% lesser sheet metal needed than Dekker.
- 2 Only the half of moulds of the Dekker wing was needed.
- 3 Sail flapping was much lesser, so the camber of the sailbars could be more normal and the torque increased. There was also lesser work in total.
- 4 The hollow profile with the thick round nose got an excellent starting torque with a lot of power.
- 5 The cost of the Van Bussel system (1, 2, and 3) were much lower than of the Dekker system.

- 6 The wind catching surface is nearly the same as the “oudhollands” system so much more storm-secure.
- 7 The speed was more regular when compared with Dekker due to the camber of the sail bars.

There is never taken patent on the Van Bussel system. Therefore there are a lot of imitation “Van Bussel noses”. The reason is, that there was partly opposition by Von Baumhauer. The leading side of Van Bussels wing is nearly identical with Von Baumhauer, despite of the fact that Von Baumhauers patent dated from 1922 and it was never used inside the terms of time. In 1936 Van Bussel started with the first system on 4 mills. The year thereafter another 20 mills. In 1938 another 16 mills and in the years after there were 23 till 27 each year. The result in 1946 was that 146 mills were “verbusseld”. Also the semi- Van Bussel wings are counted. In total there are more than 300 mills equipped with the system Van Bussel. In 1941 Van Bussel already thought about tide-powerstations.

In that time a lot of stocks were made by the firm of Pot from Elshout-aan-de-Kinderdijk. They made very good riveted iron stocks. Van Bussel thought of welded steel stocks and he asked his friend ir J. den Besten to design welded stocks, which designs were complete including strength calculations in 1945. Due to the death in 1946 of Chris Van Bussel the project stopped for that moment. Nowadays nearly all stocks of the Dutch mills are from welded steel.

In general we can state, that the Van Bussel system works very well when the mill asks much power. But at a instable wind and no or less power, the system is somewhat instable. To solve this problem, a lot of mills are later equipped with airbrakes in the Van Bussel profile. Van Bussel was against that for economical reasons! With airbrakes it is an almost ideal wingsystem. There are about 80 mills with Van Bussel noses in the Netherlands today.

The Van Bussel system is an aero-dynamic nose on the leading side of the stock. Because of the torque at low speed and braking, there are often airbrakes in each leading end. In the north of the Netherlands it was also tried combined with patent sails and 3 or 4 brakeshutters parallel to the stocks in the trailing side of the wing. This was much cheaper than an airbrake in the leading side. In the Groningen mill book of 1958 it was still to see on 35 mills, but it proved not very successful and this kind of brakeshutters was together with the Van Bussel system restored away on most mills. Today it appears on only 3 mills in the Netherlands: De Dellen in Nieuw Scheemda, the Eureka in Wetsinge and the Weyert in Makkinga. These 3 mills had formerly Van Bussel noses, but now old-dutch leading sides of the stocks.

The Bilau system

The German engineer Kurt Bilau (1872-1941) came from the airplane world and came rather fast to a wingform with a very good quality.

The system works with centrifugal weights at every end. The weights set the maximum speed of the wings. There is a striking rod through the windshaft and a reefing tackle to get extra control (speed) of the system. There were also systems without the reefing tackle; they only worked on the centrifugal weights! That was dangerous, because at stopping of the mill, the wings made maximum power! Also systems with a reefing tackle alone and no centrifugal weights existed.

The system is never wide spread used, only 13 mills in the Netherlands got the system between 1935 and 1938. At this moment only one mill has the system: corn mill De Hoop in Norg in the province of Drenthe. There are only two disadvantages to the system: expensive and heavy.

The system Van Riet

Developped by the millwright Van Riet from Goes, province of Zeeland. It is a system which looks like a aeroplane wing like the Bilau system.

The system Van Riet has a streamline nose at the leading side of the stock. At the trailing side there is one long wooden shutter, which goes parallel to the stock. The axle has 6 bearings. The system is made so, that always the same stock has to be at the underside when stopped, because there is a small winch at this end to regulate the 4 shutters. The speed is regulated by a spring and the centrifugal working of the weight of the ironwork of the system. Because less weight the system does not work so well as Bilau, and that is the disadvantage why the system is never wide used.

The miller sets the small winch at the beginning of his work. How strong the spring is stretched by the small winch is the experience of the miller. To stop the mill the shutters has to be opened. This is done by meaning of a wire to the tail which actuates the slipping construction which is situated just behind the canister of the windshaft. Pulling the wire opens the shutters. So the slipping is only used when the mill is stopped.

The disadvantage is that the system is not very storm-proof. When the mill is facing the wind exactly, there is nothing on, but at 90 degrees the open shutter of the vertical wing gets the full wind on his surface!

The system Ten Have

Millwright Ten Have from Vorden, province of Gelderland, made a system nearly the same as Van Riet, the visible difference is that Ten Have has a hemlath for extra strength and Van Riet does not has such a lath. There are about 28 mills with the Ten Have system in the Netherlands today.

The Fauël system

The last innovation took place in 1935/36 by the engineer **P.L. Fauël**. (1891-1993) The system is often called "fokwiek". (fokwing) "Fok" is Dutch for the foresail on a sailingboat. It was a marvelous sailing day in 1935. Fauël sailed with his "tjotter" on the Kagerlake along the Moppemolen at Alkemade. The Moppemolen could not start because of the low windspeed, but his tjotter sailed with reefed sails and only foresail without problems. So came the idea to fit a fore sail at a mill. He knew the miller of the mill of Bergambacht very well and at a certain moment of very low windspeed they fitted foresails of the tjotter at the inner stock with a lot of rope and some laths. On the outer stock they took out the boards and fitted no sails. The wind was to low to drive the mill. The work was done with the motor than. After fitting the foresails Fauël put the brake off and the mill started rapidly and powered even the stones inside! Nothing happened after this idea also because the flapping of the sails at passing the mill body. The Second World War started and Fauëls work abroad in Indonesia stopped so he had a lot of time for his hobby, the "fokwiek". The idea of the foresails was changed by wooden boarding and was further developed on paper.

The model on paper had even round stocks and bent sailbars! This is never used in practice. Fauël got patent on his invention in 1944 with number 56997 and the system is the most aesthetic wing improvement till now! The “fokwiek” is the same idea as foresails on sailing ships and also the wings of big passenger aeroplanes during landing.

The bent boards are made of small strips of redwood. The airbrakes have a width of about 2/5 of the with of the boarding. The opening is actuated by centrifugal forces due to the rotating wings. Also a system with a spring and wires is used and a system with a striking bar and reefing tackle to actuate the airbrakes is also used. The problem with the centrifugal system in practice is, that the airbrakes shut as the wings goes slower at braking. The power is maximal at a not wished moment!

The “fokwiek” was introduced in the magazine “De Molenaar” (The Miller) of January 1946 and the critics ware very good. One hoped that a miller was found rapidly to test the system. This introduction was preceded by extended tests during the war in the Technical University at Delft, conducted by professor doctor J.M. Burgers, also a well known man in the millworld because of the Prinsenmolenwiek. There was a model-mill between Nootdorp and Delft with wings of 7,20 meter. This mill was used before for experiments with wingsystems and Fauël got permission to use it. The mill was fitted with fokwings on all 4 ends and with 2 ends with airbrakes. The results ware very good, but it is a pity that brake experiments never ware held because of the war: at the last months of the war the mill was pulled down to burn in the stoves from people who had nothing else to burn in that very cold winter.....

The system was first made in 1946 on the mill “De Vooruitgang” of miller Manders in Oeffelt, in the province of Noord-Brabant. The system is in 2011 still made on mills which has a leak of power, often due to the surroundings of the mill. There are about 150 mills with the Fauël system in the Netherlands.

Fauël died in 1993, 102 years old.

Source: “Wieksystemen voor polder en industriemolens” door G.J. Pouw

Translation: H.P. Tiddens, 5-2-2011



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