Making tyre history

By GUSTAF O. OSVALD

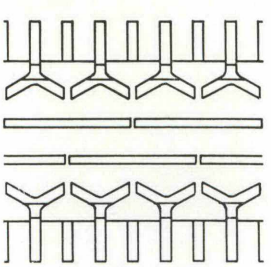
Mr. Osvald has been active in the tyre industry for several decades since the 1920's, both in Sweden and abroad.

During the 1920s, the rubber industry went through a period of great development in respect of material, processing methods and machinery equipment. This was accompanied by a rapid expansion of production, especially of car tyres. The trend started then, continues to develop today.

A great deal of what goes on in a company in connection with this sort of development is visible to all working there. But a lot that happens leaves no outward, visible sign though it is often just as important as the things that show. In fact, it is usually on such work that development is founded. It is all the work done in laboratories, in construction offices and sales departments, in administrative and business management by means of studies, investigations and planning.

When I think back on the years gone by, my thoughts often dwell on one very important development in the 1930s, something that has perhaps meant a great deal for the success of the company and demanded a lot of work over a number of years, though very few employees knew of it. Let me give an account of how the affair developed.

On 1st October 1929, I was made head of the car tyre department at the Svenska Gummifabriks AB factory in Gislaved (the name has now been changed to Gummifabriken Gislaved AB). I immediately found a number of problems to tackle. The most serious was a fairly common defect that occurred in car tyres. At that time, nearly all tyres for this use had a tread pattern with a straight rib in the middle and two parallel grooves or two ribs and three grooves. These grooves were subject to cracking. The cracks became rapidly worse and the tyres had to be discarded before they were actually worn out. All tyre manufacturers were faced with the same problem.



THE TREAD

The tread pattern, Gislaved 1930

At that time, we had quite a large scale production of dimension 6.00—19/4 with four actual cord plies, a tyre wich we also supplied to the AB Volvo car factory in Gothenburg as original equipment.

The defect described occurred often in these tyres, too, and we found this most annoying. We had already tried several ways of improving the quality: we had tried new rubber compounds and even made new vulcanizing moulds for a couple of slightly altered tyre profiles. But the result was not satisfactory. The problem was still unsolved.

In the summer of 1930, a big international rubber congress was held in Frankfurt am Main in Germany, where scientists and technicians from many countries shared their knowledge and experience. I had the privilege of attending this congress. I heard a lot of valuable information and got to know many people in my branch from different countries, and could discuss our mutual problems.

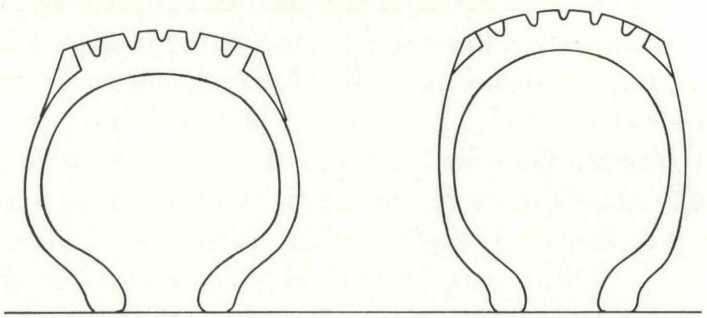
A leading research scientist in the field of rubber was there with some colleagues; he was Professor A. van Rossem, head of the State Rubber Research Institute in Delft, Holland. One of Professor van Rossem's colleagues read a paper on their research on the aging of vulcanized rubber. They had known for some time that the small quantity of ozone (an isomeric form of oxygen), present in air, brakes down rubber fairly rapidly. Thorough testing had now shown that ozone reacts most rapidly with rubber that is only streched a little, between 5 and 15 %, and destroys the rubber in a short time. Rubber that is not stretched at all, and rubber that is very greatly stretched, is affected less by ozone. When I heard this, it struck me immediately that the stretch in the rubber at the bottom of the grooves on an inflated tyre must increase the risk for damage by ozone reaction and also for purely mechanical damage through cuts. This was surely the reason for the serious defects in the tyres. I wanted to keep this thought to myself until I had the chance to do my own investigations, and I did not therefore discuss the problems with anyone else at the congress.

As soon as I had arrived back home, I made a test to see the condition of a 6.00—19/4 when inflated to the usual tyre pressure of 32 lb/sq in (2.25 kg/cm^2). In fact, the tread was stretched and became rounder, and the grooves wider — it is in the grooves that the rubber is thinnest — and at the bottom of the grooves the stretch was

10—15 %, just the dangerous point for ozone degradation. Irrespective of any ozone reaction, the smallest scratch in the groove would soon become a deep cut. Naturally, the constant effect of the ozone must aggravate all damage and cause new cuts, thus causing a more rapid increase in damage and destruction of the tyre.

To avoid this problem, the tyre should have such a shape that the grooves did not widen when the tyre was inflated. On the contrary, they should preferably close a little. In this way, the rubber would not be subject to the same wear and tear.

This was discussed thoroughly with our managing director Mr. Gösta Gislow, and I suggested that we schould discontinue making the traditional type of tyre, although it was generally considered to be correct. Instead, we should make a tyre with somewhat narrower section and with a radius of the inner contour of the tyre under the tread, that was somewhat smaller than the corresponding radius after inflation of the tyre. We decided to try this type immediately.



The old tyre section *The new higher one*

A vulcanizing mould for a 6.00—19/4 was drawn on these principles, and was made in the factory work shop, where all tyre moulds were made — both then and later. The tyre was given a new shape in the vulcanizing process, but its construction and material specification were exactly the same as previously.

We were both so convinced that the new construction principle was right, that we gradually replaced all old moulds for 6.00—19/4 tyres with moulds of the new type.

Naturally, it took quite a time before the result of the change was to be seen. But after a time, it was found that no cracks occurred in the grooves on the new tyres. Our control of the tyres was very sure: the new moulds had been marked in a slightly different way from the old ones, and each tyre, when vulcanized, was given a

code number, so that is was possible to know when it had been manufactured. Each tyre was also marked with the working number of the tyre builder.

We also had a tyre testing machine, where tyres were rotated at high speeds and with a heavier load than normal — against a big iron wheel fitted with cleats at different angles. Tests on this machine gave fine results for the new tyres compared with the old ones. However, this testing machine could not be used as much as was desired, as frequent re-building and extension work of the factory often needed increased floor space, and the machine was moved out, and finally not used at all.

The experience we slowly gained showed it to be necessary to make a successive change-over in production of car tyres to the new type. It took af few years, as the essential change in mould equipment involved considerable work and costs.

To start with, we made new moulds for the most popular tyre sizes and for all new types. During these years, there was fairly rapid development and change in the motor car, including a change-over to smaller and smaller tyre rim diameters. The rubber factories thus had constantly to change production and include new moulds for the new rim diameters.

The alteration of the tyres' shape to a higher section ratio could neither be noticed by customers or by others. Tyres were always stored and transported piled on top of each other, and were thus always a little compressed sideways — that is to say, they had a high contour irrespective of the mould in wich they had been vulcanized.

So far we have only mentioned tyres for passenger cars. Lorry tyres are much thicker and heavier in construction, and there is hardly any measureable expansion of the tread when the tyre is inflated. Furthermore, the majority of the lorry tyres at the time had a tread pattern without lengthwise grooves. Nor did we have specific, repetitive defects on the lorry tyres. Nevertheless, when constructing new moulds, we tried to some extent to adapt them to the type we had found superior for tyres for passenger cars.

In 1934 is was time to start on new tyres for a 15″ rim diameter. Such a tyre dimension was unknown previously, except perhaps for a few small European cars. At the same time, more powerful engines and other innovations on motor cars were being advertised. We then

decided to carry out new, more thorough tests on our tyres, especially testing them together with tyres from other manufacturers.

We discussed development with the management at Volvo. The result was that Volvo, in collaboration with us, bought the new model of a fairly large car — a 6 cylinder Graham, with tyres of the size 7.00—15/6. Volvo considered this car, in many respects, to be the best developed at that time. (It may be interesting to know that development work at Graham's had been led by a Swedish engineer famous in America and who, I believe, later came to Volvo.)

Having studied the car at Volvo, it was sent to us, where it was primarily used in the testing of the new 15″ tyres.

There was also a special reason why we wanted to do new tests in comparison with tyres from other factories. Over three years had passed since we had started applying our new principles of tyre construction. And now we wanted to see if development had been similar in other places. If so, this would be most easily noticed on a new tyre dimension.

For the first long trip, up to Norrland (Northern Sweden) in June 1934, the car was fitted with four different makes of tyre, all of the size 7.00—15/6. The Gislaved tyre was on the left rear wheel, which took the most wear in left-hand traffic. Most of the journey was on rough gravel roads, at the highest permitted speed. Tests continued on other poor roads throughout the country.

And the result: After approx. 1,850 miles, the left front tyre, of a wellknown European make, was cracked and damaged so badly that it had to be discarded; after approx. 3,100 miles the right front tyre, of another wellknown European make, was in equally bad shape. The right rear tyre, of a well-known American make, had to be discarded after approx. 8,000 miles for the same reasons as the first two. The Gislaved tyre was removed after about 18,600 miles for a check. It had no cracks whatsoever, nor any other damage and was not more than 50 % worn. We recorded similar results on subsequent tests, comparing with various makes of tyres, though the differences were never quite so marked as in this test.

One of the few people who knew of our efforts and our development principles and who followed our work with interest was Thure Magnusson, who became head of our sales office in Gothenburg after returning from his pioneer ork at the new rubber factory in Turkey, which we had built in 1932. He had a remarkable talent for making



Making tyres in the early 1920's was mainly a manual work. (Gislaveds Gummifabrik)

contact and becoming friends with people of all sorts. He told us of an experiment with the new tyres, which he had carried out in 1935, if I remember rightly.

One day in town, he passed a large taxi rank, with a whole line of taxis. Some of the cars were new and had Gislaved tyres. Thure Magnusson knew the taxi drivers and asked them if he could show them, by doing an experiment, how good our tyres really were. Yes, he could! He took out his penknife and made some deep cuts in the grooves. What would be the result after some time? Naturally, he gave the taxi drivers a full guarantee against possible losses due to the experiment. Both Thure Magnusson and the drivers followed the experiment with interest: the cuts did not become larger, nor was a single crack to be found in the tread grooves.

As mentioned before, Gösta Gislow had taken part in introducing the new tyre construction. A few years later, we saw proof that he had, during his short time at Gislaved, been convinced of the viability

of the new design. He left his position at our factory in February 1932 and took over management of the family firm — Värnamo Gummifabrik (rubber factory). Gösta Gislow soon wanted to expand the firm by selling car tyres. He therefore ordered his own series of tyres from us in 1935, and the moulds for these tyres were made in our workshop, wholly in accordance with our principles.

The alteration of the tyre shape in the vulcanizing process was only a step on the way to a better tyre quality. There were other defects and other causes, which we had to try to eliminate. It was quite common for the carcass to grow gradually, and this could result in cracking in different places and in tread separation. This could no doubt be prevented, and wear on the tyres could be reduced, by making the whole construction tighter. But how, when the cotton cord, from which the carcass was made, was so stretchable?

For years, one had sought cord with not only high tensile strength but also with low stress strain properties. Perhaps this was connected with the fact that the strongest types of cotton were low in stretch modulus. The world's largest tyre manufacturer often advertized, with illustrations, that their cord had low stress strain properties and their tyres therefore best!

The cord we used at Gislaved was best Egyptian cotton and had an elongation (strain at break) of 26—27 %. Usually, stretch strain tests are done on 10 pieces of cord, and the properties of the cord are judged after being subjected to a load of 10 lbs (4.54 kilos), to find the so-called average stretch. For our cord, this value was about 2/3rds of the elongation at breaking point. I worked out that one should be able to cut down to 15 or 16 % elongation instead of 26—27 % and get the desired, and the best, result without risking a reduction in the durability of the tyre. But where could we obtain a cord of such high quality?

Written inquiries to well-known cord manufacturers in England and Germany resulted in absolute "No". They could not manufacture such a quality. As I considered the matter to be of significant importance for the future, I finally decided to travel round myself and discuss the problem, and negotiate with the best cord suppliers.

This was in the beginning of August 1933. First of all I visited the firm of Frölich & Wolff, of Kassel, Germany — probably the country's largest cord manufacturers. Their director, a very polite and kind man in his late fifties, showed me round the plant and

explained how overloaded they were with orders, especially from the army: camouflage tarpaulins for army tanks and lorries, cannons etc. I also saw rows and rows of army vehicles, some with and some without tarpaulins. Due to their work burden, they just could not experiment with such novelties as I suggested.

And so my journey took me to England. There I visited the well-known firm Cords Ltd, Hedden Bridge, Yorks. They laughed at my suggestion.

How could such a small firm get the idea of using low modulus cord, when all other tyre manufacturers, from the largest to the smallest both in America and Europe, wanted cord with the greatest possible elongation? It was impossible, they said, for any responsible cord manufacturer to undertake to even try to produce such a contrary quality.

My next visit was to a very large factory in Rochdale, Lancs. — John Bright & Brothers, Ltd. The director showed me round the enormous factory buildings, where each and every one of the giant spinning machines was in full operation. It was impossible for them, he said, for such a small order as I had suggested, to experiment on a completely new spinning and twisting specification, especially since it would probably be the only order of its kind. So, here again, a definite "No".

My last visit was to James Scott Ltd, Oldham, Lancs., who had been supplying us with cord for some years. They had a different attitude towards our wishes, but could not understand that we wanted a poorer quality. Finally they promised to do what they could, although this must not involve any essential changes in their manufacture. We received a few sample deliveries, but it was not until the end of 1935 that we were promised continuous deliveries of stiffer cord. It was not at all what I wanted, but it was a step forward. The new cord had an elongation of 23 %. But by that time, other manufacturers had already started to think of the same change as we had in mind. By the end of August 1934, I had been advised that both Goodyear in England and India in Scotland had changed to a cord with a 22 % elongation, but was not given any information about the background to this decision. After another few years, there was a general change to less stretchable cord throughout the world's tyre industry, and my wish was finally fulfilled. All cord manufacturers now followed the new line.

During a visit to USA and Canada, which my colleague Einar Holmberg and I made in the autumn of 1938, we heard from an expert of the United States Rubber Co., with whom we had made an agreement to collaborate on tyre production, how and why they had changed to the new type of cord. A tyre factory in America, which was also one of the main manufacturers of V-belts, had received a delivery of tyre cord that did not meet their elongation demands. It was far too stiff. They decided to try it for V-belts, which they usually made of tyre cord. The sample belts proved to be noticeably superior to the standard type. They then decided to try the cord in tyres, too. Tests on a testing machine, and probably also on a test track, showed that here, too, the stiffer cord gave better results. And it thus became standard in their production.

In America, as in other countries, one can follow technical developments in the tyre industry through Smithers' reports, usually published with detailed analyses of well-known tyre manufacturers' tyre types, shapes, tread pattern, construction and material. We soon saw in these reports that the tyre factories mentioned above, known for their first-class products, had changed over to a cord type with a much lower elongation. We understood that there must have been good reason for such an essential alteration, and other manufacturers followed suit. All of them soon had sufficient evidence of the superiority of the stiffer cord, and it was not long before everybody had made the change-over.

The problems involving the qualities of the cord used, especially with regard to its elongation, had no doubt been studied by a number of rubber factories, and some had made a tentative change-over to a somewhat stiffer cord. But it was, perhaps, after all, the above chain of events that led to a complete and quite rapid change.

And then came rayon cord, followed by nylon cord, and these gave tyre manufacturers new problems.

During our visit to U S Rubber in Detroit, we had a chance to account for our efforts to eliminate cracking in tyres by vulcanizing them in a mould of a shape, that resulted after inflation in compression instead of stretching of the tread grooves. Our findings here were of great interest to them. They had long had the same problem and tried to solve it by additional vulcanization with electrically heated metal wires in the grooves, on inflated tyres. A patented but expensive and laborious method. Our collaboration with U S Rubber

was unfortunately discontinued due to the war, but when we resumed it in 1945, the first drawings for moulds for car tyres, both at Gislaved and at U S Rubber, were made according to our principles.

The world's car tyre manufacturers have always had different opinions on the best shape for tyres, on their construction and material in various respects, in order to reach the best possible result. It is probable that good results can be achieved through a number of different combinations of varying constructions and materials. I have tried here to show how we found such a combination of different factors, that quite clearly gave the desired result.

What I have described here is, however, only a part of the work that went on continually to improve the tyres. This was the most important aspect, but at the same time intensive work went on in order to improve rubber compounds, working methods and machinery, as well as the factory premises.

It is fairly certain that the development work described here, which started in 1930, led to such improvements of the car tyre that we were able to hold our own quite well on the market, despite our rather small-scale manufacture. As I mentined before, very few were told of how and why we carried out changes and experiments.

One of my friends at the rubber factory once asked why we had not applied for patent protection of both the shaping priciple and the type of cord. I answered calmly that car tyres had been shaped in so many different ways during recent years, that it was hardly worthwhile trying to patent such a detail. As regards the cord, it had, when we first started using it in the beginning of the 1920s, been about as stiff as we had wanted it. So this could not be patented, either. It would probably be better to keep it for oneself within the company.

Our best and most loyal customers were professional drivers. Perhaps these car — owners made a more careful study of what their tyres gave them. Many taxi and lorry owners came to visit us in those days, either individually or in groups to show us the tyres and tell us of mileages, how the tyres behaved after a re-tread, and so on. This was well before the IC movement, the car owners' cooperative, had reached such a size as it has today.

In the 1930s, people cared for their tyres far more carefully than now, since the price of a tyre was roughly double on account of the high car tyre tax, which was not removed until May 1938.

Some years ago, I think it was in 1956, I wrote to Professor van Rossem in Delft and gave him an account of what we had done based on the ideas aroused during the lecture held by his colleague in Frankfurt am Main in 1930. He was very pleased about this, and on a later occasion when I met him in Delft we had the opportunity of discussing the problems and their solutions at length.

Another interesting point is worth mentioning. At the end of 1959 I noticed advertisements in the English rubber trade press and daily newspapers inserted by the well-known English car type factory Kelly Springfield Tyre & Co. Ltd, (Kelly tyres) describing its novelty in tyres, "the high Profile Tyre". I couldn't resist writing to the director of this English firm, Mr. N. Marsden, giving him a brief account of what we had worked on in the 1930s. The reply was a very kind letter, dated 28th December 1959, in which Mr. Marsden explained that the principles on which we had founded our development were now wholly accepted by the car tyre industry, both as regerds the type profile and the stiffer cord.

What I have described here is, however, only one episode in a rapid development. The ever more powerful car engines, better roads and the consequently higher speeds both on the straight and in curves, together with quicker braking — all demand constant development towards tyres with better properties, suited to the latest demands, especially as regards safety in different road conditions. When one takes a look at what has happened since the war, it is quite right to maintain that car tyre manufacturers have kept well abreast of developments.