

Brief View of the F1 Racing's Development in 20th Century Based on the Perspective of Forbidden Technologies

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Abstract

Over the entire 20th century, there are new technologies appearing with the development of F1 racing, which included ground effect, six-wheel-car, turbo engine etc. In the process of the new technologies rise and fall, various teams underwent the same transversion, which formed a brilliant history of F1 racing in 20th century. The forbidden technologies, on the one hand, represented the advancement of automobile technique. They were also the gradual regulation of the sport's rules, which constituted a much further significance.

Keywords: F1 Racing, Development Of Racing Sports, Forbidden Technologies

INTRODUCTION

Ever since its emergence in 1950s, the F1 racing has been gaining great attention. Its development of over sixty years also witnessed the auto industry continuing to mature. Nowadays, the F1 racing, tired with the Olympics games and the World Cup, is known as one of the three largest sports events around the world. Whereas F1 racing's difference is that its regulations have been constantly modified until today. When aerodynamics was introduced into this event in 1960s, the official of F1 racing started to step on the progress where several new technologies being prohibited. The situation also existed even in the latest season. The forbidden technologies from a certain extent is the documentation of F1 racing's development. So the following article will tease out the technologies limited by F1's regulations, in order to attain a brief view of the sports' development in 20th century.

EARLY CONSTRAINTS ON AERODYNAMICS (1970-1983)

Since its birth in 1950s, F1 racing acquired its biggest breakthrough in 1960s. Great quantities of new technologies were applied in this period in the race including mid-engine (1959), vertex engine (1962), supercharged engine (1966), tail (1968) and so on. Meanwhile, aerodynamics also began to be taken seriously and used to further enhance the speed of the racing cars. After a series of innovations later, F1 racing greatly enhanced the speed of access, and therefore caused a lot of trouble. Official finally decided to disable certain technologies to solve the problem.

Variable Aerodynamic (1970)

In the late 1960s, in order to produce downward pressure, the teams began to experiment with fins. The early samples were fragile, several accidents caused devastating results. Since 1970, the governing body began to regulate the using of aerodynamics. The position and size of the flap bounded, meanwhile the variable aerodynamics became prohibited.

Ground Effect (1983)

The ground effect could be considered a milestone in the history of aerodynamics utilization in F1 racing. In the late seventies and early eighties, ground effect acquired large-scale applications, providing strong grip for racing cars with aerodynamics theory, which allowed for greater acceleration. This technology could also show the power of the car when cornering. As the first model to use the technology, Lotus 78 became invincible in the season of that year, winning five games in total.

The ground effect applied by lotus

The principle of ground effect used by Lotus team was similar to the principle of wings. Accelerate the air through narrow airways sites and utilize the different velocities of air to obtain a pressure difference, so that the car will be pressed against the ground. The principle is shown in Figure 2.2.1-1. Equipped with this technology, Lotus 78 (see Figure 2.2.1-2) was hence regarded as the classic types in every technical books of F1 racing. However, due to that the Lotus 78 chose Cosworth engine which was backward in that period, and the impacts from the airflow caused by the empennage, the power of ground effect did not really play out. In the next season, Lotus team launched Lotus 79 models which improved the empennages, by virtue of which winning the championship in seven games, swept the champion drivers, constructors, causing many of the team trying to copy this new technology.

Figure 2.2.1-1. The ground effect applied by lotus

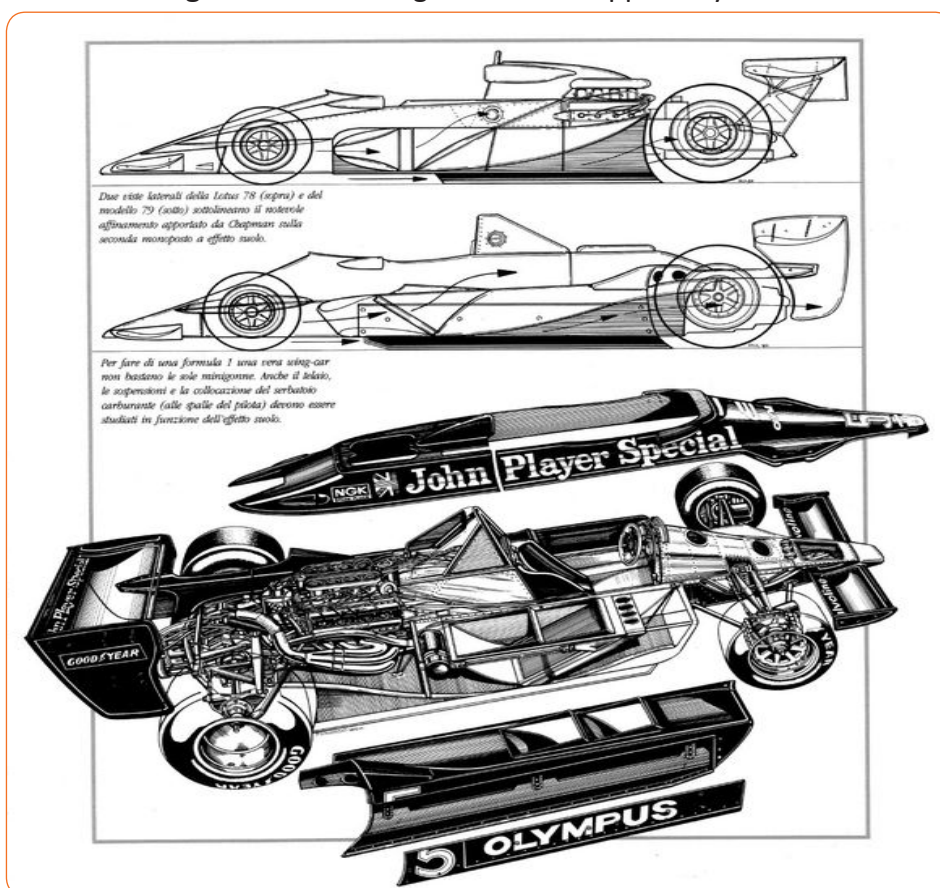


Figure 2.2.1-2. Lotus 78



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After 1982, F1 lap time further enhanced (about 6 seconds faster than before), some teams used high-horsepower turbocharged engine and ground effects together, resulting in high temperature in the cars and danger when cornering, which threatened the safety of the drivers. In fact, a lot of accidents happened at this stage. Nelson - Piquet fainted at the podium after experiencing the exhausting Brazilian Grand Prix. Rene - Arnould's Renault racing car was thrown towards the tire wall by the pressure of ground effect, Hang - Massa's car caught fire due to the same pressures, which was thrown to the crowd of spectators later. In the final stage of the 1983 season, F1 governing body had decided to ban ground effect ultimately.

The ground effect applied by Brabham BT46B

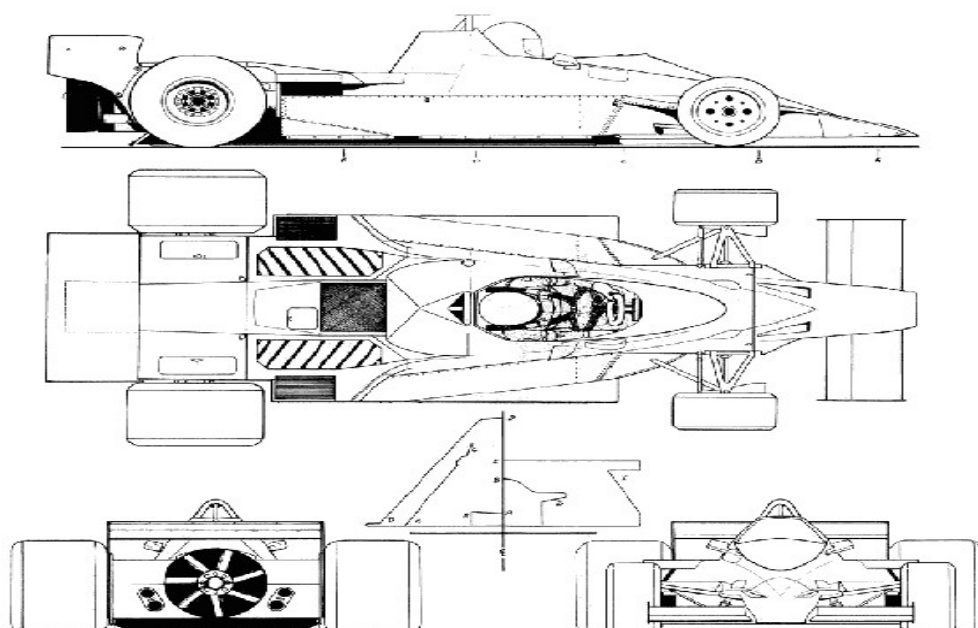
Although its designer Gordon - Murray claimed that this car was designed only to assist the engine cooling, the mainstream view was that it was actually a means to increase air velocity. According to Bernoulli's principle, in order to achieve the same ground effect which the Lotus racing realized, the only need is to accelerate the underbody airflow. What Lotus 78 used was one of the methods, the other way is to forced air to accelerate more roughly. BT46B Brabham racing (see Figure 2.2.2-1) is the practice of this point. It installed a huge fan at the rear of the car to accelerate the airflow, getting almost the same effect with the Lotus 79. Its principle is shown in Figure 2.2.2-2.

Figure 2.2.2-1. Brabham BT46B



In the Swedish Grand Prix in 1978, Brabham BT46B's debut earned a huge success, which led to complaints from the other teams. In addition, the drivers also complained that the fan will blow stones and other debris to them during the race. Then the official banned it permanently as movable aerodynamic devices.

Figure 2.2.2-2. The ground effect applied by brabham bt46b



Hydraulic Hitch

Hydraulic suspension is actually a subsidiary technology of the ground effect. In 1979, F1 officials issued the mandatory requirements of flat chassis design, in order to curb the dangerous situation which was caused by ground effect. However, the provisions demanded check in the maintenance area, but there was no clear regulation on the track. In this case, the hydraulic suspension came to world, the principle is that the racing will lower its chassis after entering the track, in order to pass the maintenance area check while continuing to get ground effect. Brabham BT49C was the pedigree of this technology. Then it rendered other teams to imitate, which made the requirements of flat chassis design in name only.

However, the drawback of hydraulic suspension was that it would affect driving. There were drivers complaining in an interview when he said, "When I was driving the car, in order to pass inspection in the maintenance areas, I had to lift the suspension in front of all the audience, and I think this stupid. This is ridiculous ah! As for driving, there was no sense of control at all. And it is so brutal to drive these cars." Eventually, after experiencing several serious incidents, the official took a total ban on the use of hydraulic suspension in 1983.

Six-wheel Racing

Six-wheel racing was born sheer by chance. From its appearance in 1976 to being banned in 1983, six-wheel racing has undergone many changes in morphology in the development process. In fact, the principles they took and also the objectives have changed greatly.

Tyrrell P34

As for the earliest version of the six-wheel racing, the initial motivation of its research and development was to improve the handling of Indy Car. However the final shape of the design aimed to reduce the aerodynamic drag by reducing the diameter of the front wheels, and by adding a pair of front wheels to compensate for the loss of grip (Figure 2.4.1-1). Tyrrell P34's performance was very good indeed. Its drivers' championship were ranked third and fourth in 1976.

Figure 2.4.1-1. Tyrrell P34



Two pairs of front wheels of Tyrrell P34 both undertook steering function, but because of this design, the drivers needed to abandon their former driving habits. Also, the judgment for choosing the best route will get some interference. Furthermore, complex structures also brought excessive weight. Smaller diameter caused a more severe wear. Therefore, this design did not reappear after Tyrrell P34.

Ferrari 312T6

Ferrari were also optimistic about the six designs in 1976. Ferrari agreed with the idea of Tyrrell that the front wheels be reduced. The third couple of wheels were placed side by side on the rear wheel, as shown in (2.4.2-1). But because of the accident occurred in the test, this plan was shelved.

Figure 2.4.2-1. Ferrari 312T6



Williams FW08B

This type of six-wheel racing changed position of the wheels further. Because according to previous estimates, the arrangement that uses four front wheels did not meet the demand of aerodynamics. Also there was a lesson from Ferrari 312T6's failure, Williams chose the design where four rear wheels were placed in lines and had the same diameter of the front wheels, as shown in Figure 2.4.3-1. However, due to several accidents before which reflected problems (drivers not accustomed to operating, driving confusion, high cost etc.), F1 racing official finally prohibited six-wheel racing competition in 1983 for the purpose of standard specification. And the amount of racing wheels must be 4, only the front wheels can be the steering wheel. Williams FW08B thus failed to participate in the race.

Figure 2.4.3-1. Williams FW08B



At this stage, almost all of the innovations and bans were related to the aerodynamics. Introduction of aerodynamics made this sport become a combination of many fields, but also increased risks. Aerodynamics attached great impact on the racing. The most significant point is that the shape of the car was transformed from the bullet to the streamline. However, streamlined appearance led to not only lower resistance but also decreased grip. Thus there came a lot of solutions mentioned

above to overcome the drawbacks. It is undeniable that each of these solutions has successfully resolved the contradiction between pressure and resistance more or less, but the success of the solution means crazier speed, which is proved to be so easy to cause danger. So a lot of the bans were created. In fact, such constraints demonstrated greatly enhancement of the racing technology within this period. This innovative have had a tremendous impact towards the later history of racing, even the history of the automotive industry.

STRICTLY LIMITATIONS OF ENGINES

Due to severe restrictions on aerodynamics in the early 1980s, many teams turned their sights on the engine in order to seek a new breakthrough. Racing technology has reached a new height in this period, but the majority of the new rules are aimed at limiting the engine. Although there were another important ban in this period, such as prohibiting the use of slicks, the use of the steering brakes, traction control, ABS and other driver assistance technologies, the purpose of these prohibitions was similar to the previous period. We will not do too many comments here.

The Rise and Decline of Turbo Engines, 1977-1988.

The use of a supercharged engine was allowed very early in the F1 racing. However, because of the fact that supercharged engine gains greater horsepower with the same displacement, in order to ensure entertaining, official required that the displacement of supercharged engine must be less than the one of naturally aspirated engine. As a result, the advantage of the supercharged engine was greatly weakened. The early supercharged engine was mostly mechanical engine. After the turbine engine (Figure 3.1-1)'s appearance, F1 still did not prohibit this emerging technology. However, due to the expensive cost of research and development, no team launched a turbocharged engine. Every team believed that an increase in fuel consumption and turbo delay (i.e., due to the inertia of the impeller reacted slowly to sudden changes of throttle responses, the engine needed response time to increase or decrease output power which should be at least 1.7 second even after an improvement) will offset the advantages of turbo power.

Figure 3.1-1. Turbine engine



In 1977 Renault tried to apply 1.5 liter turbo engine on its racing, and obtained good results, which caused internal differences of F1 official then. Because turbine engines are complex machines, the cost of its development will be fairly high. So only some of the major manufacturers such as Renault, Ferrari and Alfa Romeo might be interested in it. In contrast, the other small team was more dependent on the old DFV engine. As a result, the event was bound to greatly lose its ornamental.

After two seasons of 1979, 1980, other teams finally accepted the Renault team's outstanding performance. Some of the teams began to use 1.5-liter turbo engines. What followed were

the strict limits towards fuel consumption and turbo boost pressure. Because of advances in turbocharger technology in 1986, the engine was able to provide 800 horsepower. In 1987, the pressure was controlled at 400kPa, while raising displacement of the naturally aspirated engine to 3.5 liters. In 1988, the pressure was controlled at 150kPa, where turbocharged engine could provide only a little more power than naturally aspirated engine.

Still, as the turbo engine supplier, Honda was veritably the king of this sport. In 1987, maximum power of Williams FW11B equipped with Honda engine 1.5L turbo RA167E reached amazingly 1050 hp. Advantage of turbocharged engine was highly proved. This year, the teams powered by Honda engines swept the top four all season. In 1988, Ayrton - Senna and Alain - Prost, two drivers from McLaren using Honda engines, took victory 15 times of 16 (the only losing was because the two drivers crashed together), swept the first two in 10 races. McLaren's point was three times to the second team that year.

Eventually, in order to balance the gap between strong teams and weak teams, and also to protect the long-term development of the events, F1 issued a total ban on turbo technology in 1989, only allowing racing to participate in the race which equipped with a naturally aspirated engine, whose maximum displacement was 3.5 liters.

The Displacement Limitations of Naturally Aspirated Engines 1995

Even having forbidden turbo technology, F1 racing speed became faster and faster. And ultimately after nearly a decade with no accident causing deaths, Rubens Barrichello's serious injury and Roland Larsenberg's death in 1994 rookie season and the death of Ayrton Senna strike the alarm to this event. In addition, Carl Wendlinger underwent collision in the Monaco Grand Prix which led to coma. In such a short period of time, a number of drivers suffered accidents, prompting a tough start of F1 officials to limit the speed. Maximum engine displacement was adjusted down to 3.0 liters, while in addition to turbo charging, any other facilities of supercharging would not be allowed to use. After a season of chaos and adaptation, the 1995 F1 race season was finally back on track. The major adjustment of the past two years also made the tournament get important security upgrade.

At this stage, in addition to adjusting the rules in order to enhance security, there was emergence of new purposes such as improving ornamental and so on. Besides limiting the engine, the ban on high-tech driver assistance systems avoided the F1 falling into sheer technology race. Along with these prohibitions, F1's competition, irritation has been improved, making it a more popular sport in the world. In the long term, these restrictions will help enhance the influence of race, and help F1 return to the ranks of "people-oriented" and "sports" events.

EVALUATION

You can say that the prohibition of technologies is almost along the entire process of F1 racing's development in the 20th century. It seems that the prohibition is contrast to the spirit of speed and passion for racing, but in fact the ban in the history of racing had played a very important and positive role. They either witnessed the development of racing technology, or regulated the direction of motorsport, in order to have the entire event moved forward. From the point of this view, we can see the development of motor racing listed following.

- An increasing emphasis on the safety of the drivers, representing respect for athletes.
- Although both driver's skill and automotive technology were taken into account of the competition, it can be seen that there are a weakening on the requirement of "car" and a rising demands of "people".
- Based on the period when the supercharged engine existed but being limited in displacement, the motorsport promotes mutual comparison of different technologies.

- Despite prohibitions on many techniques, it is objective that the bans of F1 racing encouraged the development of various new technologies (such as the development of the turbine engine after aerodynamics was strictly limited), thus promoting the technical innovation.
- In some way, most disabled techniques are of great efficiency. Being officially disabled made sense for advertising of their products, such as the case of prohibition on turbine engine produced by Honda. It makes the event operations more commercial, which will help F1 with further development.
- Some bans made the strength of teams of different levels been re-formed again, giving small disadvantaged team the chance to compete once more, and thus refreshed the entire event, which will be beneficial to the long-term development.

Taking all these pieces, we can see that techniques prohibition is also an important part of F1 racing's continually development. Stepping into the 21st century, we are pleased to see that the F1 racing still has the energy, and has further developed many new technologies such as F tube, X-wing, double diffuser and so on. These techniques are also disabled within a few seasons after appearance, but they are also a sign of a creative future of F1 racing. We hope that under the regulation of various bans, F1 racing can become more brilliant, thus promoting driving technology, automotive manufacturing technology and the spirit of sport. Hoping that F1 will get a more mature future!

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