Kromschroeder technology in the RIO 2016 Olympic torch

special projects

kromschroeder

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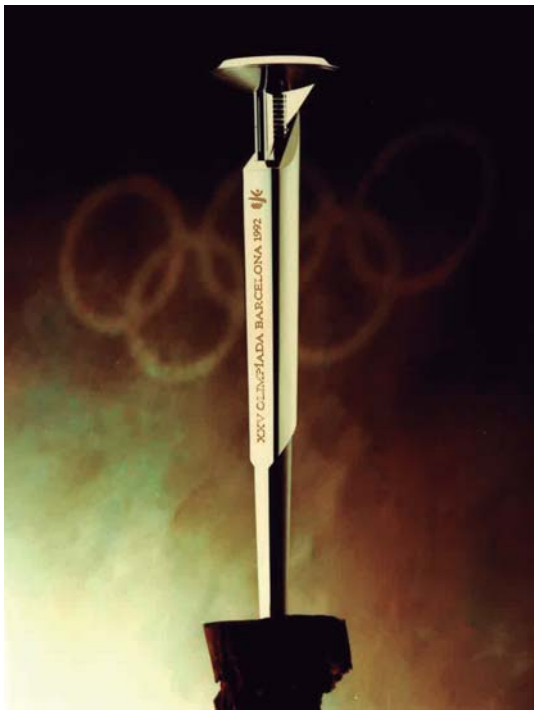
The firm Kromschroeder, SA, located in L'Hospitalet de Llobregat, which has the experience of manufacturing the Barcelona '92 torch, has designed and manufactured the internal operating and combustion systems of the torches for the RIO 2016 Olympic Games.

The origins - Kromschroeder and Barcelona '92

In 1991 Kromschroeder, S.A., located in L'Hospitalet de Llobregat, a company expert in equipment for energy efficiency and gas-fired combustion systems, was commissioned by COOB for the final design, approval and manufacture of over 11,000 combustion systems for all Olympic torches at the Olympic Games of the XXV Olympiad, Barcelona '92.

It was an exciting project and a great responsibility for the company, which ended with great success, since the Olympic flame had travelled 6,000 km and had been carried by 11,000 relays, bringing worldwide renown and experience for Kromschroeder in the Olympic sphere.



Torch of the Barcelona '92 Olympic Games

RIO 2016 - A new "Olympic challenge" for Kromschroeder

A few years have passed, but history has repeated itself.

"We did it again!" says Isidre Tort, Managing Director of Kromschroeder, as he explained the details of this important challenge.

The project was awarded after a long selection process and after participating in a public tender in which well-known companies from Australia, China, Italy, UK, Switzerland and the USA also sought to win the commission for making the torches.

Barcelona 92 served as proven experience for international participation in the tender. In an event of such magnitude, the successful development of a product with such quality and reliability requirements marks a country's international image.

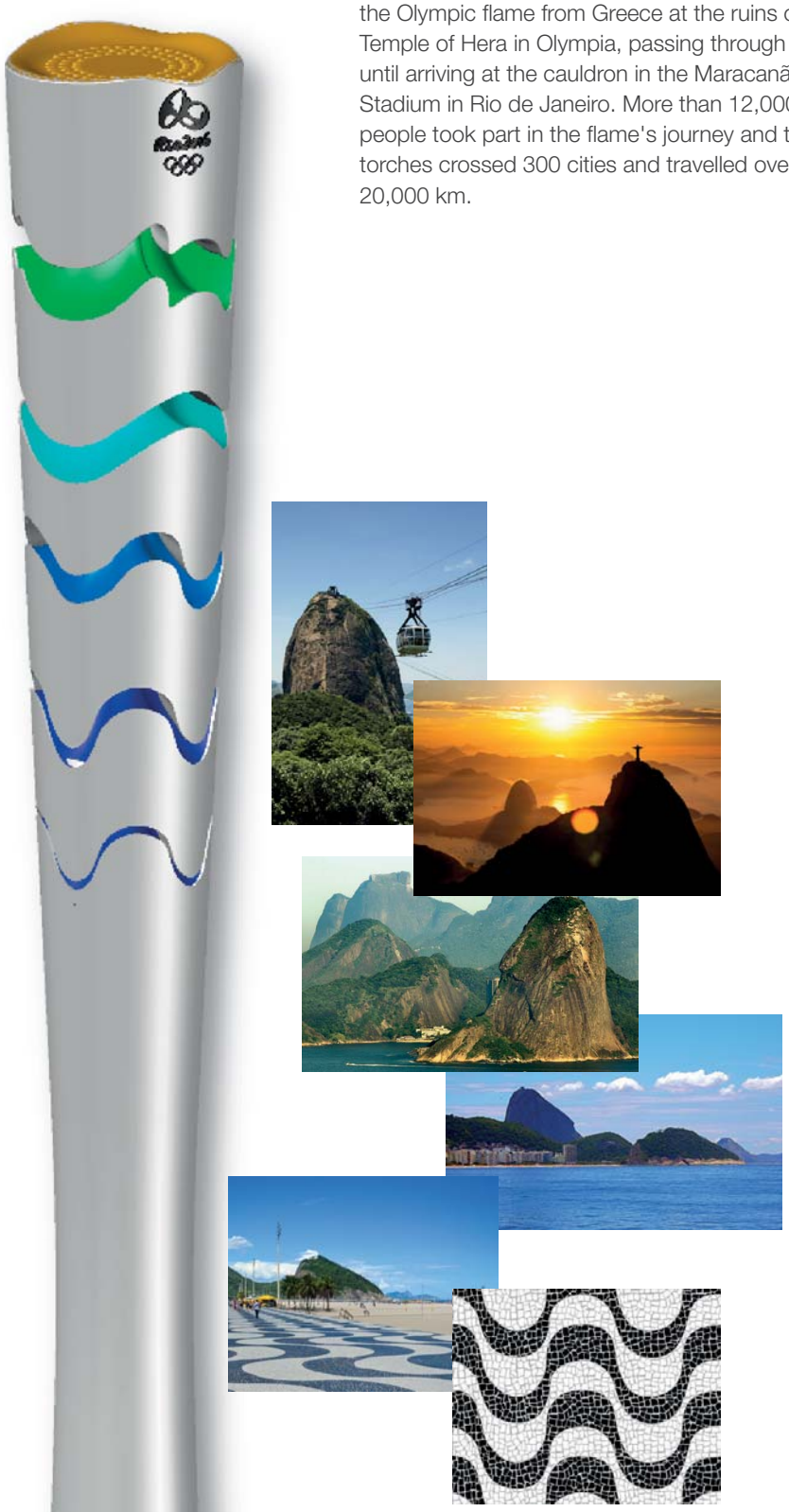
So, once again, Kromschroeder was entrusted with the design and manufacture of the internal operating and combustion systems and the burner for all 14,600 torches carried at the RIO 2016 Olympic and Paralympic Games.

The challenge was quite significant since the combustion system and the flame had to meet demanding technical specifications and adapt to a very original external torch design, which on this occasion had been created by the Brazilian studio in São Paulo, Chelles & Hayashi Design.

It is the first torch in history to have a design consisting of five recycled aluminium and plastic resin rings that move. The torch extends by almost 10 cm when lit, displaying the colours of the Brazilian flag inside, and is shaped to represent the silhouette of the mountains in Rio, the waves of the sea and the wavy pavement designs of Copacabana and Ipanema.

It weighs 1.5 kg and has a height of 70 cm when extended.

It was a great responsibility and honour for Kromschroeder to be part of the project of bringing the Olympic flame from Greece at the ruins of the Temple of Hera in Olympia, passing through Athens until arriving at the cauldron in the Maracanã Stadium in Rio de Janeiro. More than 12,000 people took part in the flame's journey and the torches crossed 300 cities and travelled over 20,000 km.



Torch design.
Places in Rio de Janeiro that inspired the shapes of the sections

The challenge of the Olympic flame

The origin of the Olympic flame comes from Greek mythology through the figure of the titan Prometheus who stole fire from the gods, which Zeus had deprived men of, in order to return it to them.

The symbol of fire was reintroduced during the Modern Olympic Games in Amsterdam in 1932. It was in 1936 when a relay system was carried out by transporting the flame, lit in Olympia, to the venue in Berlin.

The Olympic flame must remain alight during its entire journey, so it was a major challenge for Kromschroeder to achieve an optimum combustion system design and burner which would be suitable for the original manoeuvre of extending the torch when the flame is to be passed, in each relay, from one torch to another without going out, known as the "kiss".

The requirements to be met by the Olympic flame, requested by the Organizing Committee for the RIO 2016 Olympic Games, covered very demanding operational matters as well as safety and performance issues.

This involved them being easy to handle, extend and light, ensuring complete reliability and safety in all operations, and having a stable flame without going out under various circumstances and weather conditions in a tropical country like Brazil.

The Olympic flame of each torch was designed on a basis of liquid gas, with a mixture of butane and propane, which vaporizes in the burner. It has a range of 20 minutes, is visible from 200 metres away in daylight and has a height of 30 cm.

It has undergone and passed all the tests required for resistance to wind and rain. It did not go out in a constant 75 km/h wind and resisted 125 km/h gusts of wind, 50 litres/m2/h of tropical rain and 5% to 100% relative humidity. It also performed properly both at sea level and at 3,000 metres altitude.

Cross section
of the torch

Operating Principle - Extending System

The extending and retracting system was adapted to the horizontal sections of the enclosure and is actuated prior to turning on the gas.

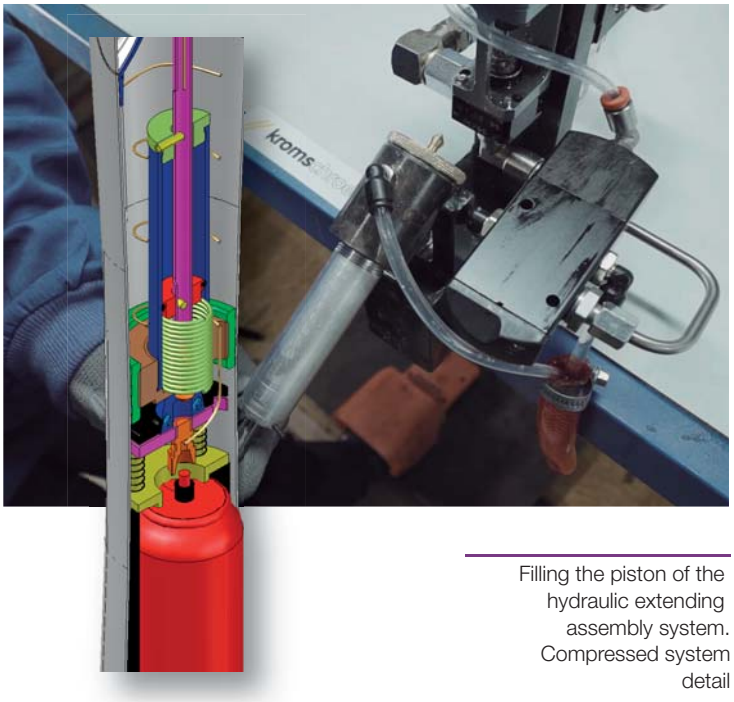
The unavailability of any outside access to the mechanical actuation of the raising of the torch rings required using the same control for turning on the gas to also activate the extending system.

The original hydraulic solution adopted is based on a safe reversible clutch system that locks through the torch control itself. This solution ensures easy retracting, managing to provide the assembly with the necessary rigidity and preventing the sections from being loose or separated from one another.

The torch is equipped with an extending system, adjustable in the production stage, which enables the smooth and gradual opening of the various modules of which it consists.

Burner

E



Filling the piston of the hydraulic extending assembly system. Compressed system detail

E

assembly detail

xtending system
assembly detail

Extending system
assembly line

Operating Principle - Combustion System

Gas tank

The design of the torch, which includes moving sections in the upper part, requires the fuel tank to be located in the base far away from the burner. The only access available for removing the tank is the control located in the base, which is also used for raising the sections.
Due to the high pressure of the fuel load, it is to be highly independent of any variation in environmental conditions and have very stable consumption, ensuring continuous operation for a minimum of 15 min.

Gas tank connection

The bottle is housed in a guiding container to ensure it is centred with the gas valve and to enable the torch to be raised even if the gas tank is not installed.
The leakproof connection is made by the movement of the assembly upwards and the pressure exerted by turning the base control.

Fuel line

In order to achieve maximum flexibility in the fuel pipe, a small diameter spiral tube is used with the fuel in liquid phase.
Fuel is taken from the bottle to the burner via a first flexible section of capillary tubing, in order to allow for the moving area of the torch, until reaching the burner.

Burner and gas dosing

The space available for the burner system is limited by access through the inside of the central raising shaft and the upper section.
Micro-capillary tubing is incorporated in the vicinity of the burner, which has the function of restricting the flow and spray of liquid fuel. This calibrated component ensures high quality and perfectly adjusted mean consumption, a specific range of 15 to 20 minutes and a flame height of more than 20 cm.

Gas spray

The restrictor (micro-capillary tubing) acts by spraying the liquid fuel, producing micro-drops at the outlet. In order to enter the gas phase, the fuel needs heat, which is to be absorbed from its surroundings. The burner design requires the heat from combustion for complete vaporization of the fuel.
The micro-capillary tube is housed centred and isolated in the central shaft in a fixed relative position with respect to the vaporization chamber.
This design cools the assembly, keeping all components protected from heat (micro-capillary tubing, shaft, and bottom plastic cover of the fifth section) so that its performance remains unchanged throughout the time of operation.

Burner / Vaporizer

This system, made of brass, consists of a capsule with a pre-chamber used for mechanical connection and cooling the fuel access area, and a final vaporization chamber to ensure the gasification of the fuel prior to injection.

In this way, gas jets are created through turbulent diffusion, which allows a visible and smoke-free flame to be produced under operating conditions. The solution is optimal for ensuring ignition, producing attractive flame shape and quality and improving its behaviour in rainy and windy conditions.

The symmetry of the assembly allows for ensuring the same wind resistance properties from any direction.

Flame stabilizer

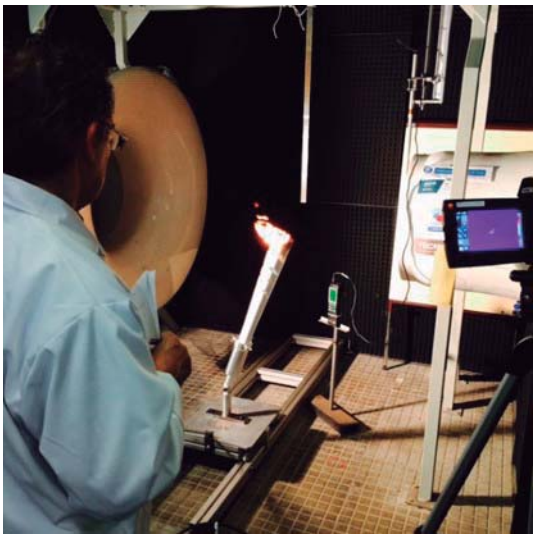
The internal diffuser or stabilizer is made of truncated cone shaped steel plate. One of its functions is to improve temperature distribution by flame retention, preventing excessive overheating of the confinement cup.

The main aim of the diffuser is to stabilize the flame on its perforated surface in strong wind conditions by creating turbulence and recirculation of gas. The functionality of the stabilizer is complemented by the effect of the perforated top cover, which improves flame stability.

Performance Testing

Aerodynamic tests

Tests were carried out on flame behaviour in the event of gusts of wind using various settings. The tests, performed at the Polytechnic University of Catalonia (UPC) laboratory, were successfully completed with constant wind at 75 km/h and gusts of 125 km/h, and with varying degrees of torch inclination (90° angle ± 15°).



Wind resistance testing
at the UPC laboratory
in Terrassa (Barcelona)

The test, lasting for 5 min with constant wind at 75 km/h and with an inclined torch (-15º), enabled us to confirm the suitability of the design under extreme wind conditions, while maintaining the physical integrity of the fifth section and adjacent components.

Rain tests

The specification required high resistance to rain at a rate of 50 mm/h (50l/m2/h => very strong rain), an amount equivalent to approx. 87 ml of water on a single torch for 15 min.

Having a design that ensures water drainage at more than 10 times the rate required, the UPC laboratory tests were passed using a quantity of water of approx. 350 ml on a torch for 15 min, corresponding to precipitation of 50 mm/h over 15 min (torrential rain).

Temperature tests

Measurements carried out at the UPC laboratory showed ideal heat behaviour for the torch even under strong wind conditions. In the logo area, measurements of 115 ºC were recorded while operating in still air and 172.5 ºC while operating in strong wind.

In the area of the cover surrounding enclosure, temperatures near 300 °C were reached.

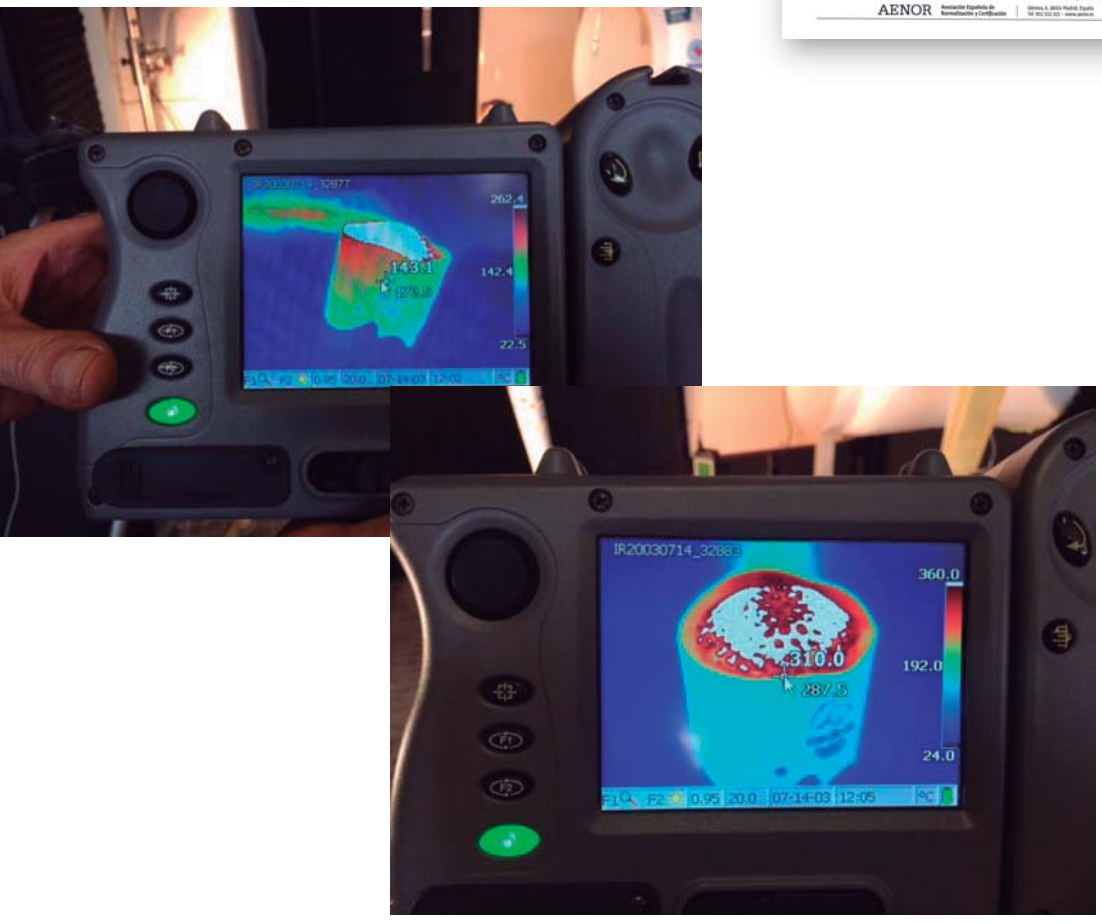
The design therefore ensured temperature levels that do not jeopardize the integrity of the torch (paint, plastic components, etc.).

Rain tests
at the UPC laboratory
in Terrassa (Barcelona)

Approved product

During the design phases of the entire combustion system and burner, under such requirements specified by the Organizing Committee for the RIO 2016 Olympic Games, all flame performance tests were verified at the Polytechnic University of Catalonia (UPC) laboratory and were approved by the notified body AENOR.

Certificates of approval issued by AENOR



Thermographs carried out at the UPC laboratory in Terrassa (Barcelona)

Experts in energy efficiency and gas.

Kromschroeder, S.A. has become a leading company in the manufacture and sale of products and systems and provision of services for the various fields of distribution and efficient use of energy.

Thanks to a highly qualified team and an extensive programme of innovative products and systems for the development of high energy efficiency, Kromschroeder, S.A. fully meets the most demanding needs and expectations of its customers.

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