

# GOGU CONSTANTINESCU, SON OF CRAIOVA - EXPONENT OF ROMANIA

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## Abstract

The paper briefly presents the life and achievements of Gogu Constantinescu, a model of engineer, formed at the schools in Bucharest and Craiova, which has achieved, based on a mathematical-related formation, outstanding theoretical foundations of reinforced concrete construction and mechanical power transmission at distance by the oscillations which spreads in the medium (liquid, solid) because of their elasticity.

## 1. Gogu Constantinescu – Son Of Craiova

Gogu (George) Constantinescu was born on 4 October 1881, in the "House Doctor" next to Michael Bravu Garden. His father was a mathematics professor, then a director of the School of Craiova, the current High school Carol I. His mother, Ana, with Alsatian origin, was a music lover and a perfectpianist. From both parents, he has inherited the talent for music, mathematics and engineering. His maternal grandfather was also an engineer.

He attended the primary school Obedeanu. It is being said that during that period he has made a telephone for communications from the bedroom with his mother at the kitchen or in the yard. From 1892 he follows the High School in Craiova. In high school he has turned his room in a true laboratory for physical and chemical experiments. In this way he has created an electric lamp based on mercury, powered by batteries, and various motors.

Due to the desire of helping his sister Maria to better handle mathematics, he has created a computer based on a mechanical system, which could make calculations up to 30 digits.

It is being said that his father George, seeing that his son likes in particular physics, chemistry and mathematics, said: "Gogu, you

should get no water carrier unless you have not the general culture which open the horizons for all specialities". Unfortunately, his father died in 1896 because of heart disease and Gogu will have to cope alone with his life.



Figure 1. Gogu Constantinescu.

## 2. Gogu Constantinescu and the Theory of Reinforced Concrete

In 1899 he takes his Baccalaureate and entered at the National School of Bridges and Roads in Craiova, graduating in 1904 as the head of the class with the highest grade

achieved by that time: 18.56 out of 20. Being an innovative spirit, he tries to demonstrate in his graduation project, the benefits of new materials and technologies. He calculated a bridge of reinforced concrete, with his own method, although the teacher bridges, Anghel Saligny, warned his students not to use reinforced concrete, material unsafe and even dangerous. This material was used, even by Anghel Saligny, but his theory of reinforced concrete, was not well implemented and a few buildings built during that period in Europe were demolished (a bridge with 23 m opening during the construction, at Prague - 1890, Bridge "Celestial Globe" from Universal exhibition from Paris - 1900, the "Black Bear" in Basel - 1903).



Figure 2. Arched bridge in the Carol Park.

Gogu Constantinescu's merit is that he has developed a correct theory of reinforced concrete and an original method of calculating bolts with fixed ends, verified in the beginning through the construction, from 1906, of an arc provided bridge in Carol Park in Bucharest. He tries, unsuccessfully, to obtain the only vacant post of engineer in Bucharest. Following the insistent appeals of his former professor Elie Radu, he is employed at the Ministry of Public Works, and between 1906 and 1908 he is also the assistant of Professor Radu to the National School of Bridges and Roads.

In 1908, as a protest against the refusal of the Technical Superior Council to accept his solutions, based on the construction of reinforced concrete, he resigned from state service and established, together with Tiberiu Eremia, a construction company that built more

bridges and buildings with reinforced concrete. In 1906 he was asked to solve a problem at the Chamber of Deputies: the elliptical wall that encircle the room started to move. He solved the problem by using a belt of reinforced concrete building and then made the covers of reinforced concrete. Upon completion of his work, deputies refused, for fear, to enter the building. He chased away the fear downloading building with bags filled with sand. The bags was not afraid!

Among its achievements in the construction industry, which can still be seen today, we may point: the Mosque in Constanta, built in 1910, entirely of reinforced concrete, whose dome is made of a web of reinforced concrete 5 cm thick although it has an opening 8 m; the tank from Periș (Ilfov county), the bridges from Lainici, two arcs of reinforced concrete, with openings of 60 m; bridges over the rivers Adjud, Răcătău or Roman, the former Minister of Works Public (now Mayor's Office in Bucharest) or the Casino in Constanta.



Figure 3. Mosque in the City of Constanta.

### 3. Gogu Constantinescu – In Exile

In November 1910 he went to England to implement his very bold ideas. In 1913 he already had 18 patents. In 1913, he goes to America in order to support in front of the Patent Office his solutions for which he demanded protection. Here he met Edison that was 66 years old at that time. Because he didn't find the necessary understanding and financial support that he wanted, he returned

to England. He got married in Richmond in December 1914, with Alexandra Cocreescu

#### 4. Gogu Constantinescu - Recognized Value

The outbreak of the First World War will facilitate the implementation of his inventions in military technology, rejected initially as being fantasia. Between 1914 and 1918 he was an adviser to the British Admiralty, a position that he re-took during 1940 to 1945, as well.

In 1919 he became a citizen English. At 45 years old, he was already famous. The English magazine "The Graphics" from 10 January 1926 – mentions him as one of the 17 most renowned scientists in the world during 1900 - 1925 along with Einstein, Lord Kelvin, Marconi, etc. Recognition can be seen by the number of patents obtained in various countries:

- England - 114 patents
- U.S. - 45 patents
- France - 18 patents
- Romania - 5 patents

Among its research in his last part of life we may remember: the problem of processing power in the sonic energy, transforming mechanical energy into heat and the use of ultrasounds in practice, including medicine.

#### 5. Gogu Constantinescu – Creator of The Sonic Theory

The most prolific part of his business and technical scientific field is the sound domain. The sonic knowledge is the power transmission by mechanical vibrations.

How was this science born ?

A legend says that the famous tenor Enrico Caruso used to impress assistance through a paradox experiment. He put a glass of champagne on the piano, departs from a certain distance and began to sing. When he reaches a musical phrase with a high note, the glass began to vibrate. Caruso seemed to increase its effort to continue that musical phrase and, in front of a wondered assistance, the glass breaks. Obviously, great enthusiasm! Gogu Constantinescu read about one of these demonstrations. Maybe he

remembered this story from his mother, notable pianist and theoretician of musical arrangements. Maybe he remembered it from his father, known mathematician. What it is sure is that he remembered that when he was 17 years old when he tried to learn musical harmony, and afterwards when he formulated a scientific theory of the sound. In fact, Gogu Constantinescu found the laws of mechanical power transmission at distance by oscillations which spread within a continuous medium (liquid, solid) because of their elasticity.

This result is a very good example to demonstrate that one of the barriers that stop creativity is linked to the previously acquired knowledge. In that time the scientists and the engineers were convinced that liquids, and especially water, are incompressible. In all the hydraulic mathematics of that time it started from the assumption that water is incompressible.

Or, based on this new science, this is the phenomenon of the liquids compressibility and spread of regular forces and periodic movements in the form of elastic waves, with the finite speed. The first sonic equipment made by Gogu Constantinescu in 1912 consists from a generator of mechanical vibrations applied at the end of a steel pipe filled with water and a sonic rotary engine placed at the other end which converts sonic wave carrying vibratory energy in mechanical energy.

Laws that apply in sonic field are identical to those of electricity field. This was the analogy that Gogu Constantinescu draw and, as René Descartes said "the method creates results", this led to spectacular results

A full tube may be associated with a conductor.

A piston that moves with the speed  $v_x$  [m/s], in a full tub of section  $S$  [m<sup>2</sup>] gives a instantaneous flow  $q$  [m<sup>3</sup>/s]:

$$q = v_x S$$

Piston speed depends on the linear speed of the connection point between the crank and the driving rod:  $v_x = v \sin(\omega t + \varphi_0)$

$$\text{and: } v = \omega r$$

$$\text{Finally: } q = \omega r S \sin(\omega t + \varphi_0)$$

$$\text{If } r = ct., \omega = ct., S = ct.$$

$$q = Q_{\max} \sin(\omega t + \varphi_0)$$

Starting from this form we can make easily the analogy between the flow and the electric current

$$i = I_{\max} \sin(\omega t + \varphi_0)$$

Pulse  $\omega = 2\pi f$ , frequency  $f = 1/T$ , and  $T$  is the time of a complete rotation. Technicians have designed the electric synchronous motors, asynchronous, single and three-phase motors.

Gogu Constantinescu created sonic synchronous motors, asynchronous motors, single, decay three phase series, shunt. (nu se intelege exact ce a creat). It is being said that the English physicist Lord Rayleigh seeing those engines in service said "The existence and operation of your engines are your field of magic. Although I have a busy life full of sound I could not imagine that transmission through water can produce such effects".

Constantinescu wrote and published a little bit, as well. In 1918 he published the first paper in London "The Theory of Sonic. A treat on transmission of power by vibrations". On 14 November 1919 he held a conference reception in the Romanian Academy.

In December 1919 the first public conference on sonic and its applications takes place. A top conference thus "It is a great joy for me to be able to present this information for the first time in public at the local National School of Roads and in the amphitheatre in which I had the honour to teach myself". And he continued with a conference in January 1920 in the same place.

As an honorary member of the Society of Civil Engineers in London he makes three distinguished speeches. The first speech, entitled "Scientist versus Engineer", was presented on 3 October 1948, just the day before turned 67 years old, the second speech was presented on 5 May 1954, being a summary of mechanical engineering development over the past 100 years. In April 1959 the expose of the third conference in which his scientific paper SONIC, the speech was rewarded with the gold medal as the best of that year.

## 6. Gogu Constantinescu - Engineer Trained at the National School of Bridges and Roads of London

As mentioned above, Gogu Constantinescu has expressed interest to final practice and therefore has made every effort to find applications of the sound theory.

### The first application: sonic machine gun.

In 1915 the Germans used a new system of drawing through the plane propellers. Solutions proposed by the British engineers were mechanical and not given desired results. Salvation came from sonic theory and Gogu Constantinescu who won the contest launched by British Admiralty for this purpose. In August 1916 there were the first tests with a plane equipped with what was to become Constantinescu Fire Control Gear or "CC Gear".



Figure 4. Gloster Gladiator, the last airplane equipped with a sonic mitralier

The success and superiority against the system used by the German aviation was clear and the official recognition is that, by the end of the war, over 50 000 American and British air planes were equipped with such systems. Considering his results, the English government built in West Drayton to Gogu Constantinescu in 1918 a very large laboratory for research and practical applications of the sonic theory, called Sonic Factories.

### Other important application: Torque converter

By applying this converter in a car in May 1923, Constantinescu has created the first car with automatic gear shift. Another interesting

proposal was making the transmission between the turbine and propeller of ships about sonic to reduce costs by making the mechanic tree. The converter proved to be applicable in cases of rail transport in order to replace the steam engines.

In 1933 he concluded a contract for the application of torque converter to engines and motorcars produced at the Malaxa Factories in Romania. The first tests were conducted in Bucharest - Oltenița, the vehicle being driven by Gogu Constantinescu himself. Because of pressures from foreign companies on Romanian politicians the project was abandoned. However, engines equipped with this system worked for a long time. The sound theory has many applications and Gogu Constantinescu has made many inventions based on these applications: sonic engines, sonic pumps, sonic hammers and punchers sonic injectors, torque converters (sonic gear boxes), generating sonic energy, many apparatus for sonic transmission and the receivers of this energy, sonic haveuza and so on. In medicine, the sonic systems can be used in ultrasonic scanning, neurosurgery, therapy etc.

Unlike X rays, sonic vibrations are not harmful. Sonic currents easily penetrate human tissues, without burning them or produce shocks. In therapy, they are extremely beneficial with a thermosonic effect (heating).

#### **Applications in aviations and military**

In the field of aviation, the application of one of his inventions, Constantinescu proposed actuating of the propellers by sonic engines. He also made an engine that triggers a 180 HP propeller, weighting only 30 kg, thus reducing a lot of the plane.

Another invention of Gogu Constantinescu was that of a cannon to throw bombs chase of 100 kg to 1 500 m, "without producing any noise, flames or smoke." Of course, the invention of this field is drawn synchronized with the machine gun blade propeller plane. Because of this application it is estimated that first world war was shortened by about a year

and Gogu Constantinescu became an official adviser to the English Admiralty.

#### **7. Gogu Constantinescu – Exponent of Romania**

He returned for the first time in his home country in 1919 with the desire to capitalize here his inventions. Surrounded by sympathy from technicians, he is elected honorary member of the Romanian Academy. However, the lack of understanding from authorities makes him leave again to England, where he has made important discoveries in the same year in November. He came back in 1933, for a short time, with the desire to apply here the torque converter (invention that replaced the boxes of speed) in the engines built by Malaxa Factories.

In 1956 he was invited to a meeting with all his former colleagues at High School Craiova but was unable to attend due to health reasons. At the invitation of the Romanian Academy, in the Autumn of 1961 (between 8 September and 8 October), at the age of 80, Gogu Constantinescu visited again Romania. He remained impressed by the technical achievements post-war, qualifying the economic development of Romania in that period as "explosive".

During his stay, he has been awarded with the title of Doctor Honoris Causa from the Polytechnic Institute of Bucharest (former National School of Bridges and Roads, where he finished the university studies). This was the first degree of Doctor Honoris Causa in the technical field, granted in Romania, awarded by the Polytechnic Institute in Bucharest. In 1963, he has returned to Romania with his second wife, Eva, to spend holidays in Constanta and to celebrate in Bucharest his 82<sup>nd</sup> birthday. With this occasion he visits the Institute for Hydro Studies and Research (ISCHIA), respectively the for stand sonic experimental research, where the inventor of St. John Basgan presents one of his inventions using the sound theory.

Conceived between 1930-1934, this invention was the first to achieve the transmission of sonic energy created on the surface by drilling lining to hoe, while digging

to vibrate up and down (without lining up drilling), so it falls vertically with a fixed frequency, digging undeviating holes. In a televised program he expressed his regret that he never had the opportunity to come back and bring his contribution to the achievements of Romania in those years.

Regret the great people! A great man, born in Craiova!

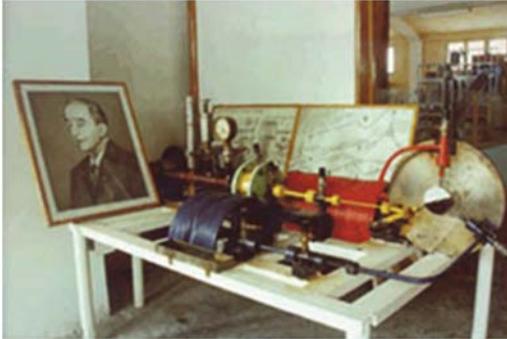


Figure 5. Gogu Constantinescu at the Leonida Technique Museum in Bucharest

### **8. Gogu Constantinescu - Always Present**

The avant-garde ideas of Gogu Constantinescu, after more than 100 years, are quoted by researchers who are trying to treat cancer and other serious illnesses through vibrations.

He was a prolific inventor, with over 193 patents, many of them explaining pioneering inventions. This explains why Constantinescu is stated in the International Patent Classification (international Class F16H33/12). He died at 12 December 1965 and is buried in the courtyard of the church in Lowick, south of Lake Coniston, England

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