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Chapter 7

CONTRIBUTION OF THE ROMANIAN INVENTOR ALEXANDRU CHURCU TO THE DEVELOPMENT OF THEORETICAL AND PRACTICAL REACTIVE MOTION IN THE 19TH CENTURY*

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The first Patent received by a Romanian inventor was obtained in 1827 by Petrache Poenaru, a student in Paris for an original fountain-pen, described as ". . . an unended portable pen, having its own supply of ink." Having the number 3208 and dated 25 May 1827, this patent was delivered by the French Bureau of Manufacturers.

Another patent was obtained also in the 19th Century by the another inventor, the Romanian Alexandru Churcu, (in Romanian, Ciurcu) aided by the Frenchman Just Buisson. It was a patent for a 'Jet Propulsion Engine' (the French original name was 'Propulseur à réaction), granted by the French Ministry of Commerce and Industry with the number 179001 and dated 12 October 1886.

Alexandru Churcu, one of the reactive motion pioneers, was born on 29 January 1854 in Sercaia village, the district of Făgăras, where his parents were exiled after the 1848 Revolution in the Romanian Province of Muntenia. The Churcu family came back to its native region only in 1856, when the exile ended. Alexandru was a practical and intelligent boy, with technical and cultural preoccupations. After studying law at the University in Vienna, Churcu returned to his country and founded in Bucharest some independent newspapers like *L' Independance Roumaine'* (The Romanian Independence). His opinions on justice and liberty and, of course, political ideas inherited from his father, led Churcu to criticize vehemently the unreasonable politics of the Romanian government headed by the chief of an old reactionary party.

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Using a contemporary method, a diabolical plan was carried out against Churcu, which was manifested by a sustained campaign to discredit him. The infamy having success, Churcu was exiled, on grounds of some unclear data concerning his Romanian citizenship on his passport.

In 1882, before his exile, Churcu conceived a very interesting and original kind of jet engine; he intended to use the reactive force of a jet exhausted from a cylindrical chamber where some special combustibles burned, to move by reaction various types of transport vehicles, especially an aerostat!

The shock of his expulsion was double, Churcu being a patriot very close to his people with its desire of liberty, independence and progress. Forced to go abroad, Churcu's choice was Paris, because he had in mind the possibility to get in touch with other Romanians having the same patriotic ideas. We may add he couldn't have forgotten that Paris was also the capital of new ideas and technical achievements about the real possibility for man to fly!

In Paris he was helped by a friend, the former Havas Agency correspondent in Bucharest, Just Buisson; he introduced A. Churcu to the cultural and aeronautical groups in Paris . . .

A NEW TECHNICAL SOLUTION IN REACTIVE MOTION AND ITS PROOF

In Paris, Churcu and Buisson were in touch with Edmond Blanc, His Excellency the Count of Hérisson, the inventors Gaston Tissandier, Emil Sarrau and Paul Vielle, the discoverer of smokeless powder.

Showing confidence toward Churcu's technical solution for the propulsion of any vehicle using reactive force, the two young inventors considered it to be useful for a lighter-than-air vehicle too. Churcu read passionately all the information concerning the aerostatic evolution. When the 1870 war ended, the French War Ministry nominated an aerostatic commission to promote the manufacture at Chalais-Meudon factory some dirigeable balloons with various dimentions. In this factory worked two specialists representative for this period: the officer-engineers Renard and de la Haye. Based on the old ideas of Henri Giffard (1885) and Dupuy de Lôme (1872) for mounting a propulsion system on a balloon, and having in view the success obtained by the inventor Gaston Tissandier with his 'electrical propelled balloon', director Renard and captain Krebs conceived, built, and exhibited at the Electricity Show in Paris their oval shape dirigible balloon, with a propeller driven by an electrical engine using an alkaline battery. It was very probable that Churcu and Buisson were present at the first 34-minute closed-circuit balloon-dirigible flight, successfully carried out on the 9th of August 1884 by Captain Krebs and Renard. Likewise, this 7.6 km long and perfectly controlled flight suggested, of course, the possibilities open to motorized dirigibles. It was impossible that Churcu and Buisson lost such an opportunity: They proposed to Gaston Tissandier to install on his balloon, instead of its electrical driver propeller, their own reactive engine, on which were mounted ducts and valves, for flight control.

But Tissandier was skeptical, and the Electricity Show organizers refused to take into consideration such an ineffective and dangerous, in their opinion, invention.

In their plans the two inventors were not discouraged, but calculated the possibilities that their engine could fly vertically, it was a wonderful anticipation in the period of 1880-1885 of the flight of heavier-than-air vehicles propelled by reactive engines. That would be a task for the future, accomplished by another renowned Romanian inventor, the scientist Henri Coanda (1880 - 1972), with the first-in-the-world reactive aircraft named 'Coanda-1910'.

Concerning the two inventors, they planned to prove the feasibility and efficiency of their invention on a vehicle. Another original idea was to install their reactive engine on a small boat. The first test with the world's first reactive boat took place on the 3rd of August 1886 on the Seine river, and it was characterized by Churcu himself as: ". . . The way on the Seine was very easy and our impression was splendid, as in a beautiful dream!" From the 3rd of August 1886 until the 16th of December 1886 they carried out other experiments, all successfully, and the jet engine was continuously refined by its inventors (Figure 1).

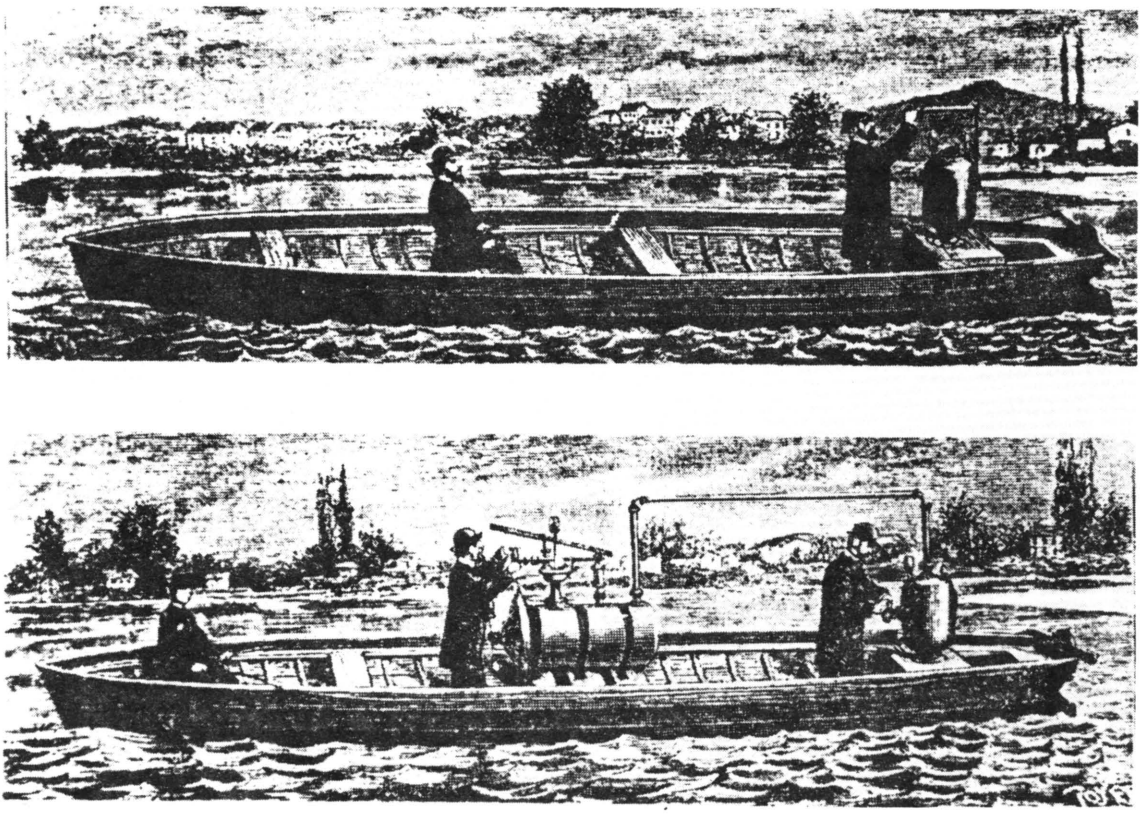

Figure 1 First reactive boat in the world invented by Alexandra Churcu and Just Buisson, in two variations, on the Seine River in 1886 (engraving in "la Nature", 1887).

In the autumn of 1886, the Head of the French Military Arsenal, Mr. Maurouard* participated as a specialist-guest in one experiment carried out by Churcu and Buisson with their reactive boat on the Sena river; in his report prepared for the War Ministry, the French expert appreciated the basic principle of the device and the original solution adopted by the inventors.

> " . . . You can imagine a big rocket horizontally installed on the rear part of a vehicle i.e. a small boat or a balloon-cabin, in such a manner that the slow combustion of a special mixture produced exhaust products, going free at the back of the mobile. Moreover, you can suppose the rocket closed in a cannon; in this case, the burning gases exhaust only by firing through the cannon's mouth, producing the well-known reactive motion of the cannon.
>
> If for example, the cannon is fixed on a boat, this reactive force would be transmitted to it and would produce its movement using only the reaction and no propeller or sails.
>
> The inventors installed on their boat a cylindrical container in which a special mixture discovered by them was burned in a closed interior and produced a quantity of gases without any solid residue.
>
> In the rear part of the cylindrical container was a hole destined to exhaust the reactive gases; the hole section was variable, using a manual actuating valve. The pressure, controlled by that valve in the cylindrical receiver, had its values displayed on a manometer. The reactive force manifested by exhausting gases caused the boat to advance continuously--about 15 minutes--in the opposite direction of the waters of Sena river . . ."

Considering Mr. Maurouard's competence and probity, his report was the best qualified proof of the successful test with the first reactive boat.

We can add there were two test versions of this pioneering jet engine: the first with a single cylindrical container, and the second, more perfected and amended by its inventors, with two containers; one for burning the propellant and another for exhausting gases.

PATENT NO. 179001/12.10.1886

The report of the French War Ministry expert Mr. Maurouard concluded with the possibility that the Ministry buy the Churcu and Buisson invention; the two inventors amended the 'jet engine' and prepared their own patent, issued by the French Ministry of Commerce and Industry with the number 179001 on 12 October 1886.

Unlike the major part of the reactive vehicles conceived in that period, which didn't go beyond the level of a paper draft, *Churcu's and Buisson's jet engine was built and tested in various versions*: One was installed on a small boat and tested as the first reactive boat in the world (3rd of August 1886); another powered the first in the world reactive rail car, which was run in 1887 near Paris at Sevran Livry. *The third type was converted into a special jet engine for aeronautical purposes, being supplied with a reactive jet-oriented system, designated to ensure perfect controlled flight and vertical take-off.* Though the inventors' main purpose was 'air conquest', lack of financial support stopped any possibility of testing this last version.

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* One of Mr. Maurouard's descendants, Mr. Guy Mitaux-Maurouard is a test-pilot on Mirage 2000 N aircraft for Dassault-Breguet.

The original form of Churcu's and Buisson's French patent (text & drawings) wasn't known in Romania until 1982; the only bibliographic source used was Churcu's scientific article published in the renowned French journal *La Nature* (No. 735 dated 2nd of July 1887).

With the assistance of Mr. Guy Buisson and Mrs. Churcu-Stroja (died in 1983), the youngest of Churcu's daughters, the Romanian scientist-writer I. M. Stefan obtained for us a copy of this very important document; it contains 10 pages of text and 3 drawings (in the original patent there were four drawings). The two Romanian specialists Stefan and Zăgănescu were in touch concerning all the details on Churcu's life and scientific achievements dissemination.

In Patent No. 179001/86 are some important scientific formulae for that period, i.e.: Very clear and correct technical expressions for: a) the principle of reactive motion; b) the reactive force formula; c) the independence of the reactive force value of the environment, as follows:

"The jet engine invented by us uses reaction produced by the forcible gases exhausted through a small hole made in the container; this reactive force propels the container in a direction opposite to that of the gases projection. This propulsion is proportional to the force of gases and to the hole section; it is independent of the environment where the gases exhaust."

The combustible used was given the importance deserved:

"The source of the gases was the combustion of a special propellant in a closed container; this mixture for which we claim to be our exclusive own is composed of 78% ammonium nitrate and 22% petroleum (kerosene); after these two components were closely mixed, we added 7% wood-carbon, well fragmented in an ammonium nitrate solution . . ."

"*Because our propellant is a mixture of some substances which are able to supply each other all the elements necessary for their combustion in a closed container*, after the charge was lighted, it will be fully converted into gases, in the absence of every contact with the environment."

The possibilities open to such a jet engine to be built in various versions depending on the destination, all being based on the same principle, were described:

"We have represented, as an example on the attached drawings, a version of our invention, but this device in which we burn our combustibles, and the gases that are developed, may have various shapes, dimensions and disposals for its main parts, all depending on its destination."

The technical solution chosen by the owners of the patent demonstrated that their invention had all the main components of a conventional rocket engine, such as combustion chamber, nozzle, propellant supplier, burners, after-burner system, lateral jet ducts etc.

". . . In two cylindrical containers, made of plate steel, took place alternately the close combustion of our special propellant. One of the two ends of those containers is mobile to assure the propellant supply. The tightness of these mobile doors was ensured by screws and a metallic set. All container-burners (similar to the combustion chambers of the rocket motor, n.a.), communicate with the third container, made also of plate steel, having the role of a gas generator; the volume of this third container is equal to the volume of the other two containers. Communication between the three containers is open only in the combustion period.'

"The gases produced in the first two containers should be in large quantity in all three closed chambers immediately after the propellant was lighted."

"In less than one minute, the pressure of gases becomes 15 bars; at this moment the valve communicating with the reactive pipes open to obtain the reactive force."

Special attention was given to the chemical reactions of the combustion process, especially so that no residue in the container-burners, should be deposited:

"The contents of gases are ammonia, carbon-dioxide, nitrogen, hydrocarbides and no solid residue. In the presence of hot metals, ammonia decomposes and doubles its volume, attending the following chemical reaction:

$$4NH_3 = 2N + 6H^*$$

We use this characteristic to amplify the power of our propellant."

CONCLUSIONS AND ACKNOWLEDGEMENTS

The last test before the contract was to be signed with the Ministry of Civil Navigation, was prepared for the 16th of December 1886. Unfortunately, when the reactive boat (supplied with a new set of valves and other unchecked systems), was on the Seine river near Clichy bridge, one container of the jet engine exploded: Just Buisson and a young technician were fatally wounded, and Churcu was wounded. The tests undertaken in 1887 at Sevran Livry with a rail car on which the tireless inventor Churcu mounted a new version of his jet engine were successfully run and this was the first jet-car in the world, before the rocket-cars built and tested by Max Valier and Fritz von Opel.†

In 1889 Churcu was responsible with all the preparations for the Romanian Pavilion at the Universal Show in Paris. The success was complete and Churcu received permission to return to his country.

One of the original versions of the jet engine was stored at the inventor's house in Bucharest, 13 Labirint Street, and after the death of the inventor, 22nd of January 1922, at the Technical Museum in Bucharest.

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* In the original form of the patent, this chemical reaction was written as follows: $4AzH^3 = 2Az + 6H$.

† In Otto Willy Gail's work entitled Mit Rakettenkraft ins Weltenall, mention was made that the first car with rockets was built in 1928 by Fritz won Opel.

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