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The New Phenomenon—Turbo Autoinjection, a New Type of Liquid Flow Circulation, New Edition

Leonid Kanevskyy

Retired Certificated Engineer, Saarbrücken, Germany
Email: lkanevskyy@alice-dsl.de

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Abstract

This work presents the study of a throttling water jet through the opening 2.45 mm in diameter, with a speed of 21.2 meters per second hitting a pressure point distance of 30 mm in a dead impact wall. The impact turns instantly the throttling water jet into the circular flow, which is rotating in a vortical manner around the mixing chamber longitudinal axis with a speed of rotation of 122 revolutions per second (The miniature injector LK26M, Figure 4 Charts 5, Figure 5). With sufficient large air intake openings, the increase of the vortex flow speed, the suction pressure of the circular, vortex flow forestall the static pressure increase in the filling in the chamber circular flow, that is directed to the air intake openings, as a result, water running out of air intake openings is impossible and only air is being sucked in the mixing chamber, the circular flow is accelerated and in a fraction of a second stabilized.

Keywords

Flow, Turbo Autoinjection, Existence, Vortex, Experimental

1. Introduction

This paper's aim is to establish the existence of the new phenomenon—**Turbo Autoinjection**.

It is a new type of circulation of liquid flow that appears inside cylindrical, conical, or spherical hollow rotationally symmetrical solid bodies. Throttling water jet turns into the circular, vortex flow of liquid, for example, in such solid bodies, water creates a static pressure drop that increases the suction capacity of injectors several-fold; the injectors also have much smaller sizes and consume considerably less energy than any known models.

The potential level of Turbo Self-Injection application is very high. Such devices could be used as shown in:

- Injectors, jet pumps [1] [2] [3] [4], here and further the numbers are the references numbers of patents;
- Foam generators [1]-[7];
- Mixers [1]-[7];
- Burners [1] [2] [3] [4];

And it could be also used in many different fields, for example, in power engineering, chemical industry, aviation, and metallurgy.

This process ensures a decrease in water and energy consumption and a decrease in harmful gases emission.

That is very important for the actual ecology situation.

This paper is a brief summary of the experimental research that I have been conducting on my own since 2002. The videos in the paper display the function of these injectors.

This paper is published to encourage further research.

2. Essence

Turbo Autoinjection can be described as a new type of the new phenomenon. It can be described as a new type of circulation of liquid flow that appears inside cylindrical, conical, or spherical hollow rotationally symmetrical solid bodies.

Throttling water jet turns into the circular, vortex flow of liquid, water, in such solid bodies and creates a static pressure drop that increases suction pressure of injectors several-fold; the injectors also have the essential greater suction capacity, smaller sizes and consume considerably less energy than any known models.

My initial intention was to produce foam, in particular, a soap foam is to be used in the shower head or for dish-washing. To achieve that, I created a mixing chamber in a pipe with a throttling disk on one end—an impact wall—on another end. I also added an outlet sideways in front of the impact wall. The mixing chamber had two more holes: one for air intake and one for liquid soap.

According to the known principles of hydromechanics [8] [9], especially Venturi, Bernoulli principle, the throttling water jet, having hit the impact wall, should fully fill the mixing chamber with water—and the water should be coming out violently from all openings.

But as it turned out, the water was not coming out of the holes for air and for soap—even when the throttling water jet was hitting the dead flat perpendicular wall in the pipe. Instead, the water was rotating in a vortical manner around the mixing chamber longitudinal axis which is parallel to the throttling water jet.

In this process, sucked-in air increases the volume and velocity of the circular vortex flow several-fold, and suction pressure is created which is 20 to 30 times higher than in previously known injectors. Because of this, simultaneous suction of both air and liquid soap is possible. In the process, a homogenous fine soap foam is created with air bubbles of 1 - 2 millimetres in diameter.

3. History

I started this research in 2002 after I had immigrated to Germany. I was 66 at the time and could not organize the research in a normal laboratory. So I have been working non-stop in my improvised home lab only using the technical means that have been affordable to myself, as somebody whose only source of income was state social security payments.

By generating several ideas, reproducing and testing each of them for the different devices mentioned above to evaluate their capabilities, taking separate measurements of each one and of each parameter.

- Water pressure in front of the throttling disk—using a customary water supply manometer;
- Water flow rate—using a 4.2 litre measuring tank;
- Pressure drop in the mixing chamber in relation to the atmospheric pressure-using a tonometer that can be set to zero. That allowed me to measure such pressure with a margin of error of ±4 hPa;
- The amount of air that is being sucked into the mixing chamber per minute—using a float-style rotameter with a margin of error of ±3%.

All my measurements, as well as conclusions, observations, thoughts, presumptions, alternative designs, and sketches of different designs and devices are spread over 500 pages.

The aim of this research was to achieve the highest level of suction pressure within the mixing chamber, the highest amount of air that is being sucked in—with minimal water flow rate and water pressure in front of the device.

- Water pressure: 1… 5 Bar before throttling
- Maximum water flow rate: 8 litres per minute.
- The main parameter—positioning of the throttling opening that defines the positioning of the throttling water jet;
- Diameter and length of the throttling opening;
- Size and shape of mixing chamber and its parts;
- Positioning and diameter of air intake openings;
- Design of liquid soap valve;
- Size and shape of dead impact wall;
- Design and sizes of parts for letting the flow out: both along the longitudinal axis of a device, and perpendicular to it.
- **Turbo Autoinjection**

This type of circular, vortex flow can be observed when looking at how my transparent injectors work—for example, injector LK18M.

The scheme in Figure 1 of this paper precisely describes **Turbo Autoinjection** that I have been observing many times when looking at the transparent injectors.

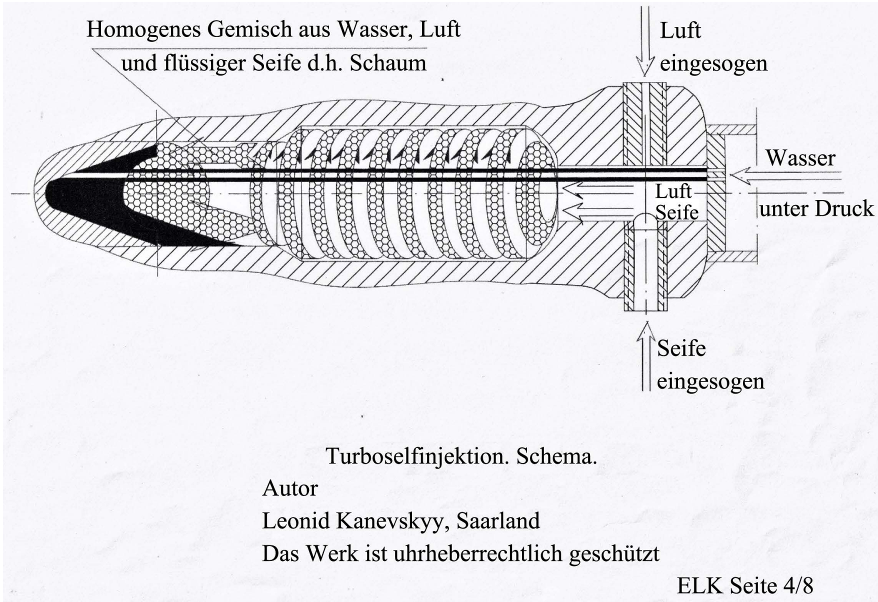

Figure 1. Scheme of the Turbo Autoinjection or the Turbo Self-Injection. That describes precisely the mediums dynamics in my injectors.

Over the time of research, I have designed, produced, tested, examined and improved 35 prototype and example devices. Since 2003, constantly and without any interval, the family uses them every day for washing with soap + water + air foam and water + air foam out of shower heads and out of devices for dish and hand washing (**Figure 2** and **Figure 3**). The devices are ready for industrial production.

4. Preconditions, Reasons, Analysis

Example I

(the miniature injector LK26M, **Figure 4** Chart 5, Item 9, and the Technical layout, **Figure 5**.

This smallest cylindrical injector, that I have designed and produced, has such parameters:

diameter—24 mm, length—40 mm,

- A throttling water jet through the throttling opening, diameter of 2.45 mm, with a speed of 21.2 meters per second hits at a distance from the throttling point of 30 mm the dead impact wall. The impact turns instantly the throttling water jet into the circular flow, which is rotating in a vortical manner around the mixing chamber longitudinal axis with a speed of rotation of 122 revolutions per second.
- Volume flow:

water—6 L/min by 20˚C, suction ability (air)—16 Ls/min,

water pressure for the throttling—4.2 Bar.

As for the volume of space, where water or water-air mixture whirl, the mixing chamber is 3 cm^3.

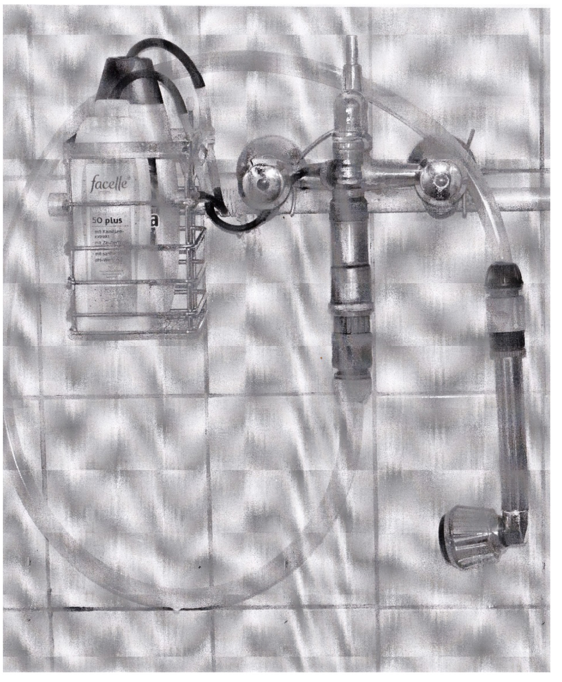

Figure 2. The shower device. A foam formed of water and air, as well as of water, air and soap is generated and forced by my injector LK27 through a very light, handy, transparent water garden hose in a usual shower head. We use now the similar shower device with the hose, diameter 15/12 mm, every day 3 times.

Figure 3. My best devices. There are among others the miniature injector LK26M, the powerfull injector LK23M, the transparent injectors, inclusive the smallest LK18M, the shower head LK10M, globular injector. All these devices are functioning and ready to run.

Pumpen(Typ, Firma)	Wasserdruck	Wassertemperatur	Saugvermögen, Luft	Wasserverbrauch	Saugvermögen / Wasserverbrauch	LangexDurchmesse	Stoff, Oberflachen-beschaffenheit	Austrittsöffnung	Energieverbrauch	Skizze einer Pumpe
Wasserstrahlpumpe	Bar	Celsiusgrad	Ls/min,	L/min		mm			J/Ls Luft/min	
1. Brand	3 – 6	12.0	6.6	3.16	2.1	210	Kunststoff	glattes Rohr	215	
2. Schuett24.de	3,5	12.0	6.66	3.16	2.12	~210	Kunststoff	glattes Rohr	166	
3. Friedrichs-Antlinger mit spiralförmiger Düse	4.0	12.0	24	10	2.4	270	Glass	glattes Rohr	166	
4. ASV Stübbe, SP 820, DN 15, Drosselbohrung 3 mm	3.9	20.0	15	10	1.5	140x33	Kunststoff	glattes Rohr	260	
DN 20, Drosselbohrung 3mm	4.9	20.0	15	5.5	2.73	180x82	Kunststoff	glattes Rohr	179	
DN 25, Drosselbohrung 2,5 mm	3.5	20.0	15	4.8	3.13	220x150	Kunststoff	glattes Rohr	112	
DN 15, Drosselbohrung 4,0 mm	6.7	20.0	30	23.5	1.27	140x33	Kunststoff	glattes Rohr	525	
DN 20, Drosselbohrung 4,5	3.9	20,0	30	20.8	1.44	180x82	Kunststoff	glattes Rohr	270	
DN 25, Drosselbohrung 4,0 mm	3.0	20.0	30	19.2	1.56	220x150	Kunststoff	glattes Rohr	192	
5. Muster LK16M, Miniwasserstrahlpumpe - Schaumerzeuger	3.9	20	**16**	**7.6**	**2.1**	**84x25**	Messing	**glattes Rohr**	185	
fertig handbearbeitet Drosselbohrung 2,75x6(Lange) mm Bohrungsoberflache-nach Bohrung	3.9	20	**13**	**7.6**	**1.71**	**84x25**	Messing	**Schlauch 1200x10mm (Innen), verbunden mit üblicher Brause**	228	
6. Muster LK15M Wasserstrahlpumpe -	3.7	20	**26**	**7.9**	**3.3**	**140x33**	**grob Messing grob Stahl**	**glattes Rohr**	**112**	
Schaumerzeuger handgemacht Drosselbohrung 2,65x1,4(Lange) mm	3.7	20	10	7.9	1.26	140x33	grob Messing grob Stahl	Schlauch 1200x10mm (Innen), verbunden mit üblicher Brause	292	
7. Muster LK23M fertig handbearbeitet Wasserstrahlpumpe - Schaumerzeuger Drosselbohrung 2,5 x 7(Lange) mm Bohrungsoberfläche-nach Bohrung	**4.2**	20	**30**	**6.6**	**4.55**	**180x33**	**Messing**	**glattes Rohr**	**92,4**	

LK- gekürzt Leonid Kanevskyy. 16, 15, 23 - Ord nungsnummer (chronologisch) der LK – Muster, Prototypen. M – modernisiert.
Saugvermögen der Muster LK wurde mit einem Schwebekörpermessgerät mit Genauigket ± 3% vom Endwert gemessen.

Wasserstrahlpumpen. Tabelle 3. Autor – Leonid Kanevskyy. 03.08.2015 ELK Seite 5/8

Pumpen, Schaumerzeuger	Wasserdruck	Wassertemperatur	Saugvermögen, Luft	Wasserverbrauch	Saugvermögen / Wasserverbrauch	Langexmax. Durchm	Stoff, Oberflachen-beschaffenheit	Austrittsöffnung	Gewinde: Wasserzufuhr/Luft -Bohrung	Energieverbrauch	Auslaufrichtung bezüglich der langen Pumpeachse
	Bar	°C	Ls/min,	L/min		mm				J/Ls Luft/min	
1. Muster LK16M, Miniwasserstrahlpumpe-Schaumerzeuger	3.9	20	**16**	**7.6**	**2.1**	**84x25**	Messing	**glattes Rohr**	Halbzoll auß./ M6X5 innen	185	**senkrecht**
fertig handbearbeitet Drosselbohrung 2,75x6(Lange) mm	3.9	20	**13**	**7.6**	**1.71**	**84x25**	Messing	**Schlauch 1200x10mm (Innen), verbunden mit üblicher Brause**		228	**senkrecht**
2. Muster LK10M Wasserstrahlpumpe -Duschkopf	4	20	20	7.9	2,53	170x26	grob Messing	glattes Rohr	Halbzoll auß./ M6X5 innen	158	senkrecht
handgemacht Drosselbohrung 2,6x1,4(Lange) mm	4	20	16	7.9	2	170x26	grob Messing	durch 18 Öffnungen Durchmesser 1,0 mm		197,5	senkrecht
3. Muster LK23M Wasserstrahlpumpe- Schaumerzeuger handgemacht Drosselbohrung 2,5 x 7(Lange) mm	**4.2**	20	**30**	**6.6**	**4.55**	**180x33**	**Messing**	**glattes Rohr**	Halbzoll auß./ M6X5 innen	**92,4**	**senkrecht**
4. Muster LK20M Miniwasserstrahlpumpe-Schaumerzeuger handgemacht Drosselbohrung 2,6x1,4(Lange) mm	**3,7**	20	**20**	**7.9**	**2.53**	**90X26**	**grob Messing**	**glattes Rohr**	Halbzoll auß./ M5X5 innen	**146**	**entlang**
5.Muster LK24M Wasserstrahlpumpe-Schaumerzeuger handgemacht Drosselbohrung 2,75x6 (Lange) mm	**3.7**	20	**32**	**7.6**	**4.2**	**160X45**	**grob Messing**	**glattes Rohr**	Halbzoll auß./ M6X5 innen	**87,9**	**entlang**
6. Muster LK18M Miniwasserstrahlpumpe, **durchsichtig** fertig handbearbeitet Drosselbohrung 2,5 x 1,4(Lange) mm			**Wirbel, Wasser mit Luft Schaumstrahlsrotation demonstriert dieses Muster**			**60X26**	**Kunststoff**		Halbzoll außen		**senkrecht**
7. Muster LK25M, Wasserstrahlpumpe-Schaumerzeuger, handgemacht Drosselbohrung 2,5 x 7(Lange) mm	**4.6**	20	**30**	**6**	**5**	**155x32**	**grob Messing, verzinkter Stahl**	**glattes Rohr**	Halbzoll auß./ M6X5innen	**92,0**	**senkrecht**
8. Muster LK17M, Miniwasserstrahlpumpe-Schaumerzeuger fertig handbearbeitet Drosselbohrung 2,40x1,4(Lange) mm	4.4	20	**23**	**5.47**	**4.2**	**84x27**	Kunststoff	**glattes Rohr**	Halbzoll auß./ M6X3innen	**104**	**senkrecht**
9. Muster LK26M Miniwasserstrahlpumpe-Schaumerzeuger, die kleinste, handgemacht Drosselbohrung 2,5 x 7(Lange) mm	**4.2**	20	**16**	**6**	**2.66**	**40x24**	**Messing**	**glattes Rohr**	Halbzoll inn./ M4X5innen	**157,5**	**entlang**

LK- gekürzt Leonid Kanevskyy. 16, 10, 23.. Ord nungsnummer (chronologisch) der LK – Muster, Prototypen. M – modernisiert.
Saugvermögen der Muster LK wurde mit einem Schwebekörpermessgerät mit Genauigket ± 3% vom Endwert gemessen.

Wasserstrahlpumpen , Auslese. Tabelle 5. Autor- Leonid Kanevskyy. 28.06.2016 ELK Seite 6/8

Figure 4. Charts 3.5. The readings of my devices including in comparison with the known models are listed here.

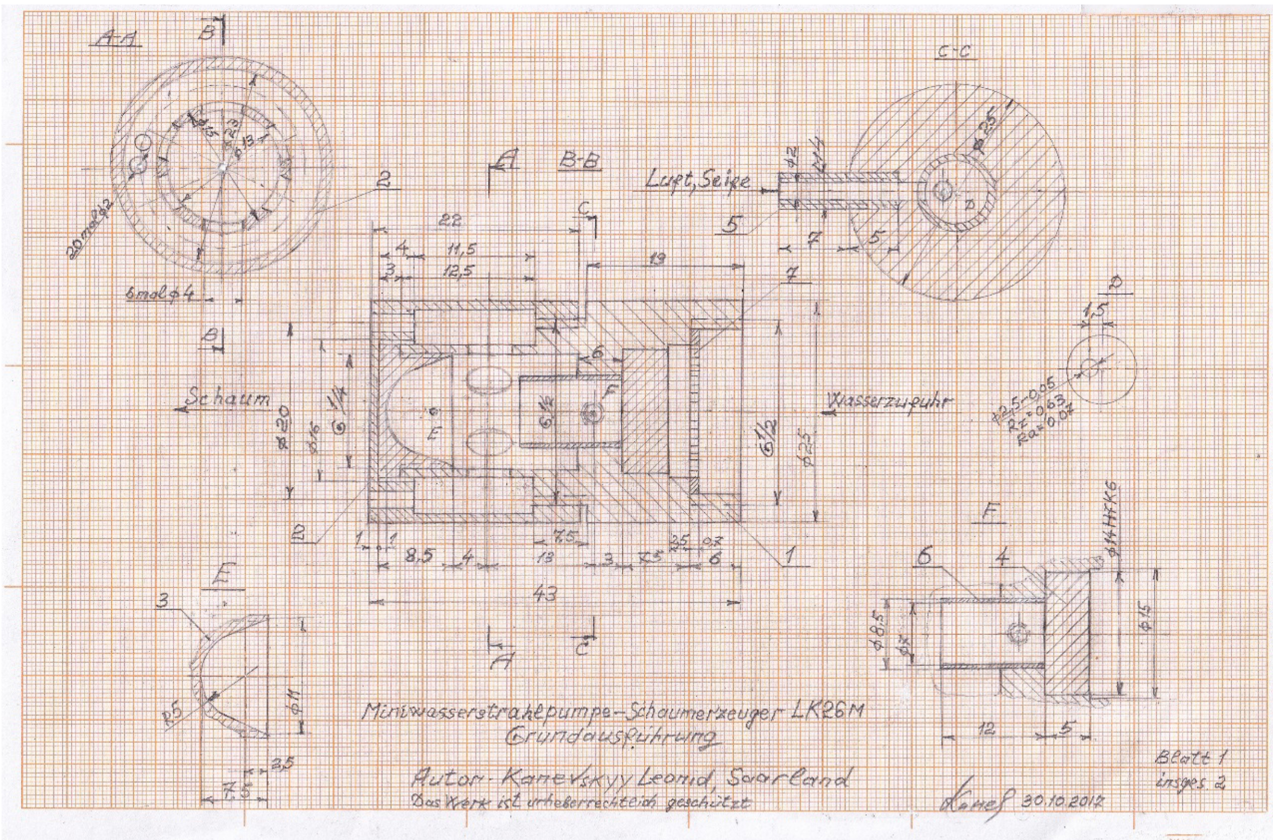

Figure 5. The miniature injector LK26M, the smallest injector, that i have produced. The technical layout.

- Volume flow per second/mixing chamber volume-relation:

Water/mixing chamber—100 cm^3/3 cm^3 = 33.3; water-air mixture/mixing chamber—366.7 cm^3/3 cm^3 = 122.2

Despite such a small mixing chamber and relative great volume flow, air suction is stable and reliable.

Moreover, the suction ability is enough big for simultaneous suction of both air and liquid soap and it is possible to wash hands and dishes with the foam formed from water and air, as well as from water, air and soap (s. video—Example II).

These videos demonstrate the dynamics of the medium in my transparent injectors and the 100% reliability of the devices when all the necessary operating working conditions are met; they also demonstrate:

Example II

https://youtu.be/CSN2CYzHk9Y

- There is a suction capacity in the mixing chamber.
- When all air intake openings are unblocked at the same time (they had been closed with a hand previously) at once, abrupt spring up water into the circular, vortex flow of air + water foam, which is rotating at a very high speed around the mixing chamber longitudinal axis.
- These devices can be used for washing with a foam form of water and air, as well as of water, air, and soap. It can be utilized in shower heads, water taps

and dish-washers.

Example III

https://youtu.be/Q6WNTUj4GRc

- The video demonstrates that my devices are 100% reliable when used for handwashing or dishwashing with the foam that consists of water and air, or of water, air and soap. The process requires a significant back pressure in the mixing chamber which appears when the outlet diameter is 5.5 mm.

Example IV

https://youtu.be/6rkQA-BoMpA

This is a uniquely small injector, the shortest in the world. Made of transparent plastic, it is only 60 mm long, and utilizes a transverse ejection of a foam made of water and air. The parameters of the process are as follows:: pressure for the throttling—4.2 Bar, water flow rate—6 l/min, suction ability (air)—16 ls/min, air hole diameter—2 mm (LK18M).

As shown in the video, a short wire is inserted into the air hole first. Because of it, the air hole diameter was reduced to 0.4 mm. The air supply, vortex flow rotation speed and suction capacity are all minimized, and water gushes out of the air hole heavily. After the wire is removed and the air hole diameter is instantly increased to 2 mm, the static pressure dropped and air supply, vortex flow rotation speed and suction capacity are all instantly on the maximum level. As a result instantly too only air is being sucked into the injector, and the air hole is not letting out a single drop of water.

Hence it appears significant example:

A throttling water jet through the compression opening is 2.45 mm in diameter, with a speed of 21.2 meters per second hitting a pressure point distance of 30 mm in a dead impact wall.

The impact turns instantly the throttling water jet into the circular flow, which is rotating in a vortical manner around the mixing chamber longitudinal axis with a speed of rotation of 122 revolutions per second (the miniature injector LK26M, **Figure 4** Charts 5).

It is possible to conclude:

With sufficient large air intake openings, the increase of the vortex flow speed, the suction pressure of the circular, vortex flow forestall the static pressure increase in the filling in the chamber circular flow, that is directed to the air intake openings, as a result, water running out of air intake openings is impossible and only air is being sucked in the mixing chamber, the circular flow is accelerated and in a fraction of a second stabilized.

This is a paradoxical find—because the size of the air intake openings in the mixing chamber must be significantly increased in order to ensure absolute reliability, efficiency and intensity of these devices. A "common sense" would suggest doing the opposite, *i.e.*, decreasing the openings.

Readings from the best of the devices are listed in **Figure 4** Chart 5 of this paper; and **Figure 4** Chart 5 demonstrates the readings of my injectors in comparison with the known models [10].

Injectors, jet pumps, foam generators, and mixers utilize a short mixing chamber, not a diffuser. In this chamber, the throttling water jet turns into the circular, vortex flow after hitting a dead impact wall. This flow rotates around the rotational symmetrical axis of a hollow solid body, and this axis is parallel to the throttling water jet.

Figure 4 Charts 3 and 5 demonstrate that in the injectors an increase in maximum suction ability also increases the amount of air that is being sucked per 1 litre of water. That means an increase in the coefficient of injection, whereas in the previously known injectors an increase in the maximum suction ability leads to a significant decrease in the coefficient of injection [10].

Technical layouts of the main types of devices have been designed and fine-tuned. These can be used for producing new devices that demonstrate the results shown in Figure 4 Charts 3 and 5with repeatable accuracy.

There are separate layouts in Figure 5 and Figure 6.

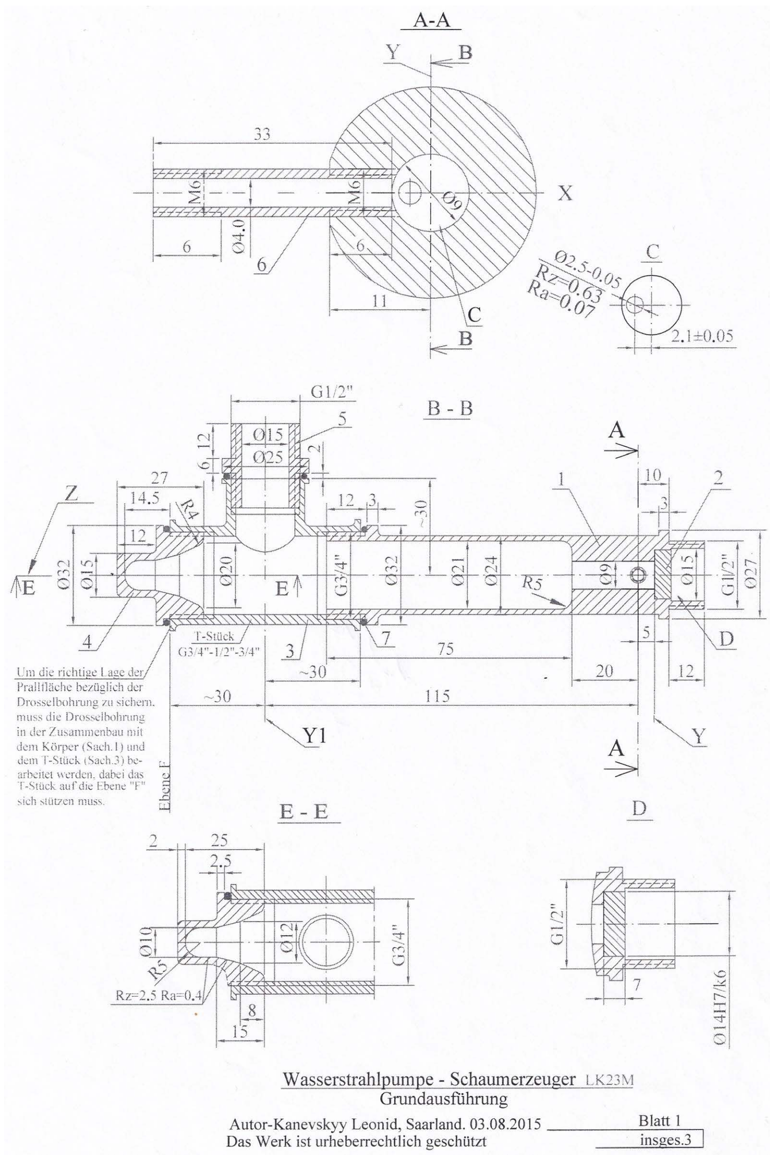

Figure 6. The injector LK23M, the relative powerest my injector. The technical layout.

The novelty and inventiveness of this invention are protected by six German patents [1] [2] [3] [5] [6] [7] as well as the application for the grant of a patent in Germany [4].

On 20th January 2016, I have passed the devices listed as No.'s 1 to 6 in the **Figure 4** Chart 5 to Professor Franz Joos [11], head of Jet-Powered Machines Laboratory at the University of Bundeswehr, Hamburg, to test their potential use to design a new type of burners.

Professor Franz Joos defined the results of my work as "very interesting, very interesting".

5. Results

The results of the experimental work: scheme of the Turbo Autoinjetion, devices of different types, the readings of my devices, the technical layouts—see figures in the parts 3 and part 4.

6. Conclusions

As a result of the experimental work the existence of the new phenomenon – **Turbo Autoinjection has been** discovered.

A significant example is as follows:

A throttling water jet through the compression opening is 2.45 mm in diameter, with a speed of 21.2 meters per second hitting a pressure point distance of 30 mm in the dead impact wall. The impact turns instantly the throttling water jet into the circular flow, which is rotating in a vortical manner around the mixing chamber longitudinal axis with a speed of rotation of 122 revolutions per second (the miniature injector LK26M, **Figure 4** Charts 5).

It is possible to conclude:

With sufficient large air intake openings, the increase of the vortex flow speed, the suction pressure of the circular, vortex flow forestall the static pressure increase in the filling in the chamber circular flow, that is directed to the air intake openings, as a result, water running out of air intake openings is impossible and only air is being sucked in the mixing chamber, the circular flow is accelerated and in a fraction of a second stabilized.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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