THE PATENTS OF SLAVOLJUB PENKALA

Boris Puhlovski

One of the most talented Croatian technical inventors was undoubtedly the engineer, Slavoljub Penkala. He was born on 20 April 1871 in Liptovsky Sv. Mikulaš, at that time part of Slovakia, where his parents lived for a while. On moving with his family to Zagreb in 1900 he became known for his great knowledge of measuring instruments in factories and various institutes.

During the rule of the Czarina Maria Theresa it was the official policy of the Court to send physicians, veterinary surgeons, technical engineers, craftsmen and expert masters to some of the larger towns in Slavic countries. This tendency to penetration of Germania in order to educate and qualify the proletariat of the Slavic east and south for various practical occupations, mainly with the intention of Germanizing and recruiting the peasantry into the Croatian Military Border, continued up until the beginning of the 19th century. Entire families moved from Germany, Austria, Poland, Slovakia, Bohemia and Hungary to some towns and even small places in the Triune Kingdom, where local industries formed and thus many immigrant-experts adapted very well to their new surroundings.

In Zagreb the pioneering activities of the immigrants yielded very good financial prosperity and many immigrant families soon became highly regarded in Zagreb, mainly because of their expert work and expansion of European culture. Because of their aspirations for social affirmat ion and economic prosperity in their new surroundings, and also due to the business warmth and helpfulness of the hospitable Croats, they succeeded in integrating with Croatian life - accepting the language, customs and way of life.

In time many newcomers to Croatia from European regions became dedicated Croats. Their patriotism was reflected in unselfish and useful work for Zagreb in their new homeland.

The name Penkala became world famous

When, in a small Slovakian town, a son, Eduard, was born to Franjo Penkala, of Polish nationality, higher cadastral engineer of the Austro-Hungarian Monarchy, and Marija, nee Hannel, from the Netherlands, his family never dreamt that the name Penkala would become world famous and that he would be the progenitor of the fame of this surname.

Although young Eduard graduated in chemistry on 19 February 1898, at the Higher Technical School in Dresden, he showed great inclination to inventions of practical value. His inventive spirit was decisive for his obtaining a suitable appointment in Zagreb. At first he lived at No. 15 Franjo Josip's Square (today King Tomislav's Square) and later as the family grew at No. 17, where he quickly commenced to announce his inventions.

The family settled down in Zagreb, and increased from year to year. First two sons and a daughter were born in Opatija and ten years later a son, Krunoslav, (Civil Engineer). At the time when the Hungarians and (Khuen's informers) wished to Hungarianize everybody and everything, his uncompromising attitude reflected his solidarity with the Croatian nation, which was particularly appreciated by Croatian intellectuals. Even more so when he Croatianized his name into Slavoljub, and later signed all documents with that name. Evidence of this was seen during the official swearing-in ceremony when he was appointed Supervisor of all Standard Measures in Croatia on the 14 June 1904, which he proudly signed with the name, Slavoljub.

The appointment, based on an order by the Hungarian Government in Budapest, required expert knowledge and universal technical culture. As Slavoljub Penkala had been educated in several European centres, he had been able to see many technical achievements at that time and to follow professional literature, which greatly broadened and enriched his intellectual scope.

The first invention: a rotating toothbrush

The invention was registered as a patent application on 26 October 1905 in the Royal Patent Office in Vienna, under No. 25153, and was approved on 15 March 1906. The patent application, translated from German, is as follows:

Class 30 b
Issued 10.8.1906
Royal-Imperial Patent Office
PATENT DOCUMENT NO.25153
Eduard Penkala from Zagreb

The submitted invention consists of a rotating toothbrush, which differs from the present usual brush according to its specific simplicity of construction and manner of use. The brush works perfectly smoothly. Although rotating toothbrushes are already known, their operation is complicated and unsafe. The main feature of this invention is the principle of mixing, the principle by which the kitchen mixer works, whereby continuous pressure of the palms induces simultaneous, inverse movement of the handle of the mixer and in this way the brush handle turns quite safely and accurately.

In essence the rotating toothbrush consists of three parts: a cylindrically shaped brush, a protective casing for the brush and a mechanism by which the brush is set in motion.

The rotating brush, which is the object of this invention, is presented in the drawing, as an example for production. Fig. 1 shows a vertical crosscut of the brush (according to A-B Fig. 4), and the second position of the spring is shown with an interrupted line. Fig. 2 shows the side view of the brush. Fig. 3 gives a vertical view (according to C-D Fig. 4), and Fig. 4 a view of the brush from above. A cylindrical brush (1d) is fitted to the upper end of the handle (2) in the middle of which there is a narrowed crosscut section (3) the purpose of which is described below. At the bottom end is a conical milled holder, whose end rests on a screw propeller (4) so that the handle, in this position, can rotate. The screw propeller (4) acts as a sliding bearing for the handle and supports a forked spring, consisting of two diagonally placed arms towards the front (5,6) bent at both ends (7,8) so that they form two arms directed towards each other. The bent end of the spring (7,8) rests on the

narrowed part (3) of the handle, as can be seen in Fig. 4. The ends of the spring are enlarged (9,10) in order to prevent it dropping off. The spring functions in two ways: as a spring for the fork and as a clip spring, so that both arms (7,8) press the handle. Consequently, due to the pressure on the fork, both arms slide one along the other thereby activating the handle, (similar to a hand mixer), and at the same time the brush. The bottom of the handle (2) lies on the screw propeller (4) and the top is in the casing, so that by loosening the screw propeller the handle and the brush are moved down, by which the handle can be completely removed from its upper base and from the casing. The handle and the brush are fitted with a casing (11,13) whose lower end is attached to the stationary part, i.e. the bearing (12), while the other end is in a semi-cylindrical casing, into which the cylindrical brush fits. The casing is (3) spherically enlarged (14) with appropriate openings for the springs. Part (3) of the handle (2) is pressed into the spherical part between the two arms (7,8) of the fork. The brush functions by pressure on the fork, which causes continuous rotational movement of the handle and the brush, by means of the arms sliding one along the other alternately back and forth. The construction of the handle, casing, brush, etc. can, within the framework of the invention, be modified. Thus, for example, the handle can be made of twisted wire, providing a path for the screw propeller, and bevelled ribs can be included on the inside areas of both arms, so that during use significant resistance of the spring is achieved, with silent running. However, it is important that the two oppositely directed arms of the forked spring, pressed into the brush handle, maintain the motion by merely sliding one along the other, without any special mechanism, such as a cogwheel, etc.

Patent applications

1. A rotating toothbrush, characterised by a forked spring with two oppositely directed arms pressed into the handle of a brush, which when pressed simultaneously, activate rotational movement of a cylindrical brush, like a mixer.
2. A rotating toothbrush, according to Patent Application No.1, characterised by a handle (2) inserted into a casing with its lowest part resting on the base of a forked spring, fitted on a movable or screw propeller, and with its upper part supported in the casing (3), so that by loosening the screw propeller the handle can be extended from the casing.

Ten years ago the Americans electrified the rotating toothbrush, which was used like an electric shaver. However, the idea of a rotating toothbrush originated in the head of an inhabitant of Zagreb, Slavoljub Penkala, eng.

The mechanical pencil - a world-wide invention

Slavoljub Penkala achieved worldwide acclaim for his invention of a mechanism to replace the wooden pencil, which must occasionally be sharpened. Penkala's sons, Eduard and Ivan, recall that their grandmother once told them that when Slavoljub was a grammar school pupil he cut the length of a pencil with a knife and took out the graphite lead, the so-called "heart" of the pencil. He then tried to push it into a narrow tube with a fine spring, so that while writing the lead came out of the holder when pushed 1-2 ml into a wider tube or casing. His object was to make a mechanical pencil that would not need sharpening with a knife or pencil sharpener, during which the "heart" of the pencil often broke. The idea was good but realisation was still primitive. Several years passed, during which Slavoljub graduated from the University, before he was able to improve his invention. Finally, on the 24 January 1906 he registered a patent application at the Hungarian Royal Patent Office in Budapest, for his first mechanical pencil, under the family name. We give below the original patent document, translated from Hungarian.

Issued on 8 October 1906
Royal Hungarian Patent Office
Patent document
No. 36946
IX/a/b class
MECHANICAL PENCIL
Eduard Penkala, Royal Hungarian Technical Supervisor in Zagreb
Registered invention on 24 January 1906.

The object of this invention is a pencil whose lead does not need sharpening and with which we can continuously write, without additional means or effort, until the lead is used up. This is achieved in a relatively simple way. Namely, in the extended, hollow part of the pencil is a movable, hollow metal insert, whose narrower part is a part of the pencil and the function of the other part is to tension a spring, which rests on the protective casing of the pencil. Thus, in the process of writing the metal insert, in contact with the paper while the lead is being used, is pressed into the hollow and releases the length of lead needed for writing.

The pencil, which is the object of this invention, is presented in the drawing as a production model.

Fig. 1 shows a vertical crosscut of the pencil, and Figs. 2, 3 and 4 show horizontal crosscuts according to A-B, C-D and E-F. The casing is made of a suitable material (1) and inside the hollow part of the casing (2) is a slightly longer, functional metal insert (3). The insert (3), which contains a fine lead (5) is in one part a pencil (5) and the other part rests on the inside of the pencil and with its other end (2) compresses a spring (7) inside the casing (6). The lower part of the insert (3) is conical and this end is used for writing on paper, so that the lead (5), when the pencil is held at an angle while writing, only protrudes as much as necessary to enable writing.

The pencil can be used in the usual manner.

We assume that the lead (5) is pushed into the hollow of the insert (3). Due to the pressure as the lead is used during writing the insert (3) retracts further into the hollow casing (2) until the needle (8) hits the wall (6), which is in fact the end of the indentation, i.e. until the lead is used up. When retracting into the protective casing the lead (5) rests on one end of the pencil on one side and the spring (7) rests on the lower wall (6) of the casing and is thus adjusted to release as much lead as needed for writing.

The lead is very thin and does not need sharpening. When writing or pressing it will not drop out of the protective casing (4) due to friction. In order for the lead not to fall out, the upper

fork of the pencil spring can be smeared with candle grease, so that it sticks to the upper area of the insert. The form and production of some parts can be altered within the framework of this invention. The pencil could be made so that after one lead has been used up, another lead automatically proceeds into the hollow (6) of the pencil insert (3). The essence of this invention is that the lead, while pressing on the paper during writing, is pushed out of the insert and is thus released for writing.

Patent application

The pencil is characterised by a thin lead, which is pushed by a spring into the hollow of the pencil, whose lower part is in constant contact with the paper during writing and which, because of the pressure while writing, is forced out of the hollow insert of the pencil.

In order for his mechanical pencil to write finely, he cast the fine graphite lead himself and inserted them into the metal holder. A special needle, on whose end a small spiral spring was soldered, slowly pressed the lead during writing so that it continually protruded from the holder.

As Penkala was not satisfied with the first mechanical propelling pencil on the 24 August 1906 he registered an improved version of the mechanical pencil at the Royal Hungarian Patent Office, under No. 38353. This time the spiral spring was replaced with a flexible half-sphere, so that the lead came out easier from the insert into the pencil holder.

The new patent registration, translated from Hungarian, was as follows:

Issued on 28 March 1907
Royal Hungarian Patent Office
Patent record No. 38353
IX/a/b class
MECHANICAL PENCIL
Eduard Penkaka
Royal Hungarian Technical Supervisor in Zagreb.
Additional invention concerning No. 36946, registered on 24 August 1906.

The object is invention No. 36946, i.e. a method for production of a pencil. Improved production of a pencil.

In this protected invention of a pencil the bottom of the steel wire is in constant contact with the lead for writing, which in practice has not proved very successful. Therefore the present invention is an attempt to correct this fault.

The following improvement has been made. The inside of the casing on which the lead rests has been made elastic, so that when the conical tip of the pencil is pressed onto the writing surface the hollow metal insert, lead and wire are simultaneously pressed to the same extent into the hollow insert (pushing the lead out of the metal insert). With the pressure is stopped the wire and lead, due to the flexibility of the lining of the casing, again protrude (as much as needed for writing) and the hollow metal insert remains in place, so that only part of the lead protrudes from the metal insert.

The attached drawing shows the rear wall (6) of the hollow casing, with a small spiral spring (9) which is slightly extended in the centre. The wire (7) which is slightly wider on the inside, has an enlarged top, like a pinhead (10), which is rests on the spring (9).

Writing is carried out as follows.

First, the metal insert (3) is pulled out a little from the casing (1) and the lead point vertically pressed onto the writing surface, whereby the metal insert (3) and the lead (5) press the spring (9). When the pressure stops the metal insert remains in place and the lead, by means of the wire (7) and the spring, protrudes from the steel insert for as much as needed for writing, ensuring that the lead will always appear.

The elasticity of the rear wall in the hollow (6) of the casing can be achieved in another way, for example, so that the rear wall consists of an elastic plate, or this can be achieved in another appropriate manner.

Patent application

Under No. 36946, the protected form of the presented pencil is characterised by the fact that the interior of the hollow casing is made flexible by means of a spring (9) or some other elastic material, and the lead point (5) for writing is pressed out onto the writing surface, by means of a wire (7) as a result of pressure on the spring (9).

One drawing attached.

The mechanical propelling pencil aroused great interest in the world, including America, the country of inventions. Very soon Penkala constructed a spiral insert which, by turning the body of the outer holder, the lead was gradually pressed, as required, from the propelling pencil. This invention has not changed to the present day! Penkala produced all the models of mechanical pencils on the turning bench in his small workshop, first at No. 15 Franjo Josip's Square (today King Tomislav's Square) which he converted as early as 1902. On the basis of the first ten samples of propelling pencils orders arrived from all large European towns. Thus very soon 100,000 propelling pencils has been ordered. Newspapers carried photographs and reports on the pencils which did not need to be sharpened, which were equally long and acceptable for all hands. All professions were interested in the propelling pencils. The new mechanical propelling pencil became a necessity for everyone.

Penkala immediately commenced serial production of his pencil in a small factory-workshop at No. 3 Marija Valeria Street (today Praška Street) in Zagreb. As every commercial object usually has its trademark, Penkala also had the inspiration for this. The older generation will remember the head with a comical large ear and pointed nose, and a huge propelling pencil stuck behind the ear. The head was produced in plaster, ebony and cardboard, and large advertising placards and small vignettes were printed.

Further development consisted of the production of coloured graphite lead. Penkala constructed a double propelling pencil, which wrote from both sides of the holder. From the hollow holder two pencils could be pulled out, on one side blue and on the other red. After writing the part of the pencil from the coloured side would again be pushed into the holder, by which the lead of the pencil was protected. These two-coloured

propelling pencils were a sensational invention. All those who used two colours in their work, such as bookkeepers, engineers, technicians and others, were delighted with such a propelling pencil. The propelling pencils were produced from a type of ebonite which Penkala found (Ebonite is a hard plastic mass produced by vulcanisation of India rubber, with a large quantity of sulphur and is thus frequently called vulcanite. Ebonite, of different hardness, was once used to make telephones, electric isolators, combs etc. Today modern plastic masses are used).

After achieving great success with the classic shape of the propelling pencil, Penkala had the idea of stylising it ‡ today this would be called designing it - for women, i.e. silver with a top on a chain. He subsequently produced propelling pencils of different sizes and lengths with different coloured tops. Frequently the colour of the holder was the same as the colour of the lead. Painters used multicoloured propelling pencils.

Orders for various types of propelling pencils came from all over Europe, and even from countries overseas. As Penkala did not have sufficient capital to open a large factory for propelling pencils, he looked for a financier and partner. Consequently on the 5 October 1911 he signed a ten-year agreement with the wealthy industrial brothers, Edmund and Gavro Moster, for the production of propelling pencils and other relevant inventions for the propelling pencil. It was agreed that he would receive 6000 kruna annually from the brothers and 33 and 1/3 percent of the shares, while the brothers would receive 66 and 2/3 percent of the sale of the propelling pencils. The propelling pencils were so sought after that the brothers opened a factory in Berlin where hundreds of propelling pencils were produced for the whole of Europe and America. From the agreement it can be seen that Penkala sold the Moster brothers the rights to 12 of his patents. Penkala received patent documents from Hungary, Austria, Germany, England Denmark, Italy, France, Sweden, Switzerland, Belgium, Russia, Norway and Canada. Although the agreements were not particularly favourable for Penkala he was forced to conclude business partnerships, in order to distribute the mechanical propelling pencil in the world. With his salary as Controller of all Measures in Croatia, and with the money from the factories of Moster and Sons, Penkala he continued to invest all his acquired capital in new experiments, for the realisation of his ideas and combinations of a chemical and mechanical character.

From month to month Penkala improved the propelling pencil with regard to lead hardness. By combining the ratio of graphite, clay and lead dust he cast different black and multicoloured leads. He produced flat, multicoloured propelling pencils for foresters and carpenters, which were needed in their profession. The mechanical propelling pencil not only captured Croatia but the whole world.

Penkala's son, Krunoslav, told me an interesting anecdote. Soon after the First World War an inhabitant of Lika returned home. His children asked him what he had brought from the great world. Slowly taking his things from the suitcase Mile answered that he had brought them a pencil that they didn't need to sharpen. The disappointed children ran to their school bags and quickly took out their propelling pencils, "Dad, we knew about propelling pencil even before the war"! Namely, some European countries had sold the Zagreb propelling pencils to the Americans, and they had found their way to our emigrants.

To prevent the ink dripping in the pocket

Not long after the appearance of the first propelling pencil Penkala announced a new patent, the fountain pen. The nibs were of 14 carat gold, mounted onto a spiral insert which was pulled out and pushed into a cylindrical holder/insert. The fountain pen was filled with ink by means of a pipette. Unfortunately it could not be turned upside down in the pocket, as the ink often ran out. In order to eliminate at least to a certain extent this drawback Penkala invented the clip, which was mounted on each fountain pen and if required, on the propelling pencil. The words Propelling Pencil-Patent was engraved on each clip. Later people carried their fountain pen and propelling pencil in the upper outside pocket of their jacket. Today the clip is a component part of the top of each fountain pen or ballpoint pen. Clips are designed, frequently as a component part of the top, plastic or metal. Thanks to Penkala's invention of the clip, draughtsmen, engineers, physicians and all those who use the ballpoint pen and fountain pen can carry several different ballpoint pens in their top pocket

The inventive spirit of Slavoljub Penkala did not rest. In 1907 he opened a laboratory at No. 5 Tuškanac St. (today the "Cibona" Sports Society) under the name "Elevator". Here he performed various chemical experiments, including the dry ink invention. The fountain pen with dry ink was filled with clean water. The water in the fountain pen gradually dissolved a hard insert of specific chemical composition, which gave the solution the desired colour, according to the type and colour of the insert. Today, similar inserts of different coloured dry ink for the fountain pen are in everyday use, seventy years after Penkala's pioneer discovery of dry ink.

Thus the fountain pen became the property of every educated person. The awkward inkpots, which had frequently turned over and "soaked" everything around them, disappeared from offices. Expensive household inkstands became museum exhibits, and all kinds of penholders disappeared. Schoolchildren no longer kept little bottles of ink tied with string to their school bags. Students wrote notes with a ballpoint pen or a fountain pen. Dark and light blue predominated, although green ink was also used. In many countries green ink was known as "diplomatic" ink. Teachers filled their fountain pens with red ink for correcting homework and examinations. The manufacture of multicoloured ballpoint pens expanded in the whole world, from four-coloured to six-coloured ballpoint pens, for which the pioneer idea had started in the head of an inhabitant of Zagreb, Slavoljub Penkala.

Author's address:
Prof. Boris Puhlovski, Ph.D., M.Eng.Aer.
President of the Society for the Advancement of Science "Faust Vrančić"
President of the Zagreb Astronautical and Missile Club
4/11 Ivan Mažuranić Square, Zagreb
Tel: 449-673