

A Swiss Watchmaking School Escapement Model

J. Schwarzentrub, Ecole d'Horlogerie Bienne, 1892

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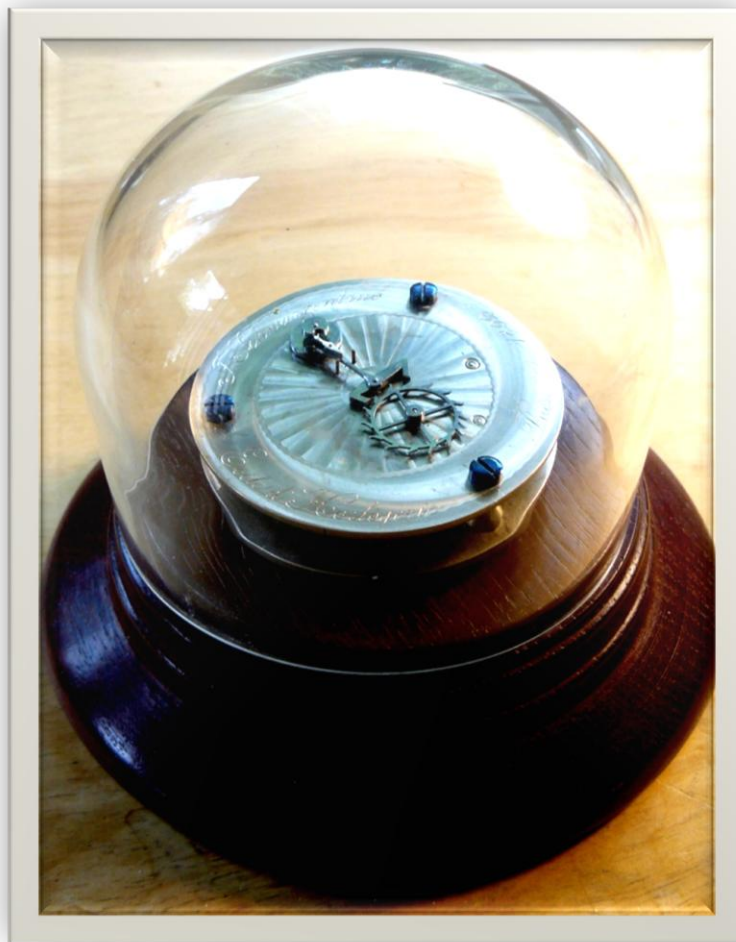
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Introduction

This treatise discusses an escapement model engraved with J. Schwarzentrub//*Ecole d'Horlogerie/Bienne 1892*. An escapement model is an enlarged, working model of the double duty mechanism that advances the hands of a watch at regular intervals, while keeping the watch running by drawing power from a spring. This model represents a Swiss anchor escapement. This type of escapement has been used in the vast majority of quality pocket and wrist watches since the first quarter of the 19th century. Essential parts are a curiously toothed escapement wheel driven by the main spring, which intermittently transfers an impulse to the balance wheel through the action of the 'anchor' or 'lever' to keep it oscillating or 'swinging'. For each half swing of the balance wheel the escapement wheel advances by one tooth. The resulting intermittent motion of the escape wheel pinion is used to advance the hands of the watch to indicate time. There is usually no timekeeping function in an escapement model. If desired, please consult the Appendix to review the terminology associated with the Swiss anchor escapement and a simple explanation of the working of such an escapement. Perhaps this is useful for non-horologist (like me).

Escapement models were used in all watchmaking schools to demonstrate and teach the essence of escapements in an easy- to-observe, large (and slower) scale. All schools had school-owned collections of models of various types of escapements to do this. In some schools students built their own escapement models to gain early practical experience in mechanical work and to develop an understanding of the nature of an escapement. Most escapement models built by students were signed by them and the name of the school and became prized possessions and exhibition pieces after the student left the school. They are now highly collectible.

Following a description of the model, the treatise traces the early history of the Bienne watchmaking school in Switzerland and introduces other escapement models made there, or appearing to be related to the Bienne design. Finally, I explore the personal history of J. Schwarzentrub and his father (also J. Schwarzentrub) and their business endeavors in the Swiss city of Grenchen. In an addendum I offer various pieces of information on escapement models made outside of the Bienne school in Switzerland, France and Germany.

The Schwarzentrub Escapement Model

Figure 1 (on the cover page) is a view of the escapement model as it presents itself today [1]. It is likely that the finely turned base of an exotic wood and the glass dome are later additions. It is a model of a very typical Swiss anchor (or lever) escapement from the second half of the 19th century (and later). The model is built around a top and a bottom plate, each about 72.5 mm in diameter and 2.1 (top) to 2.2 (bottom) mm thick. The space between the plates is 9.9 to 10 mm. Three turned spacers separate the plates. Three screws with blued heads attach the

top plate to the spacers from the top. Three short, pointed feet with threaded ends attach the bottom plate to the spacers. The feet locate the model in pocket holes drilled in the wooden base. It is not held in the base otherwise: it simply sits there. On the top plate there is the typical steel 'club foot' escape wheel and an anchor with shaped ends, mimicking the faces of the separate stone pallets normally found in the escapement of a real watch. There is an impulse roller (with steel impulse pin) and a safety roller with a safety dart on top of the anchor (Figs. 2 and 3). The steel escape wheel has 15 club teeth. It measures about 20 mm across the feet. The distance from the center of the escape wheel to the axis of the rollers is about 31 mm.



Fig. 2: Top view.



Fig. 3: Close-up of escapement.

The brass balance wheel and the flat, blued balance spring are located between the two plates (Fig. 4), as is the spring barrel that drives the escape wheel across a train of two wheels.

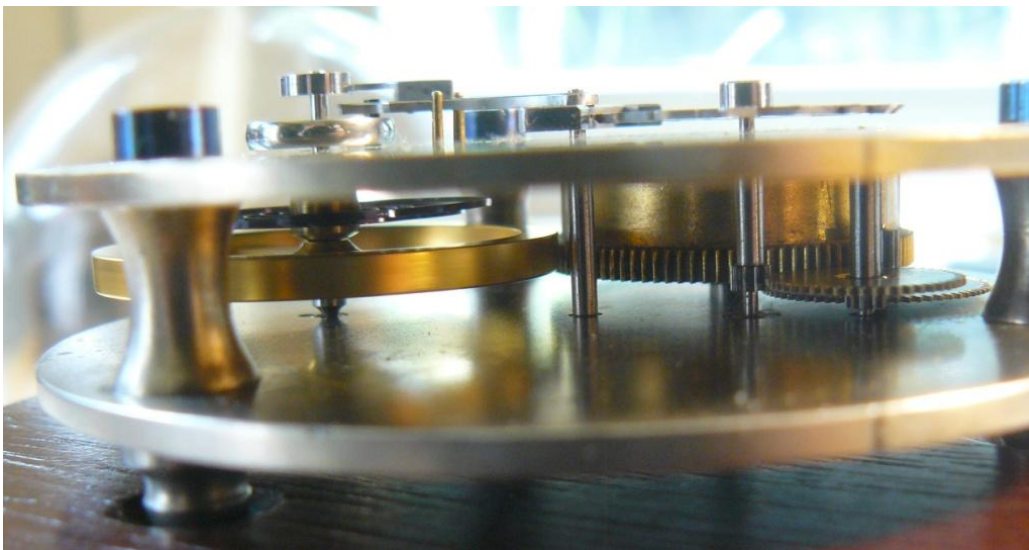


Fig. 4: Balance wheel and -spring, spring barrel with two-wheel gearing to the escape wheel.

The ratchet wheel (with click) of the winding mechanism and three feet are located outside the bottom plate (Fig. 5).



Fig. 5: Outside of bottom plate with (damaged) winding ratchet and click. The brass *chaton* holds a jewel supporting the balance wheel pivot.

The winding arbor is much too short to access it reliably with a cheap Chinese, soft brass key. Winding accidents in the past have probably led to about 40% of the ratchet teeth missing. I found it best to use a small (4 inch), high quality adjustable machinist wrench to grab the short arbor. When winding it in the future it is best to wind it only $\frac{1}{2}$ turns, making sure the click has engaged and is holding before removing the winding torque. Such a limited windup is sufficient to set the model in motion for 15-20 minutes. I do not know how long this model would swing with a fully winding. I guess at least six hours. The escapement operates with a one second full (back and forth) swing of the balance wheel (1 Hz). In modern parlance its speed is thus 7200 vibrations (or beats) per hour (vph). Most modern wrist watch escapements operate at 28800 vph or higher. The slow speed and the large size, of course, are what make such a model a suitable object for study in the school environment, or, later in the life of the maker, as a display piece on a work bench or in a shop window.

The plates are made of German silver (*maillechort*) [2]. This identification is supported by the nice silvery appearance of the polished top surface and the non-magnetic nature of the plates. There seems to be a jewel in a kind of *chaton* supporting the balance wheel pivot (Fig. 5). There are no other jewels.

The maker's inscription is not terribly well centered, and the 'w' in Schwarzentrub does not look like a proper 'w'. The top plate is decorated with two concentric circles of double and triple squiggly lines, with most of the space within the inner circle decorated with sunburst stripes.

The Watchmaking School of Bienne and its Escapement Models

The watchmaking school of Bienne (Biel in German) was founded in 1872 as the seventh government supported watchmaking school in Switzerland [3]. All earlier schools were located in French speaking areas of the Jurassic arc. Bienne/Biel is an officially bi-lingual city at the foot of the Jura range in the Kanton of Bern. In 1872 it had a population of about 12000. Attempts to attract watchmakers to the town early in the 19th century had failed. One of the first significant watchmakers was Ernst Schüler, a political rebel and refugee from Frankfurt. He started a clock making (1842) and pocket watch business (1844). He used parts sourced from elsewhere in the Jura mountains. In 1845 the city council voted to offer a tax incentive for watchmakers to move to Bienne/Biel in order to make watchmaking a more complete local industry. This program ended in 1849, but it had an impact beyond this date. In 1846 there were 150 persons employed in watchmaking in Bienne/Biel, in 1850 about 400-500. This increased further to 1500 in 1873 and to more than 3000 in 1889. Some manufacturers and politicians thought that the quality of Bienne/Biel watches had deteriorated deplorably and planned to stem this decline with the establishment of their own watchmaking school. Private and public funds became available, and the legal base of the school in the community of Bienne/Biel was established in 1872. The school opened on August 4, 1873 with just six students. This increased to thirty in the first ten years. Its first home was an existing building on the edge of a cemetery, variously described as the gravedigger's or cemetery gardener's house, or an unused memorial hall (*Abdankungshalle*). In 1876 a three-story building was erected on the same piece of land to house the school.

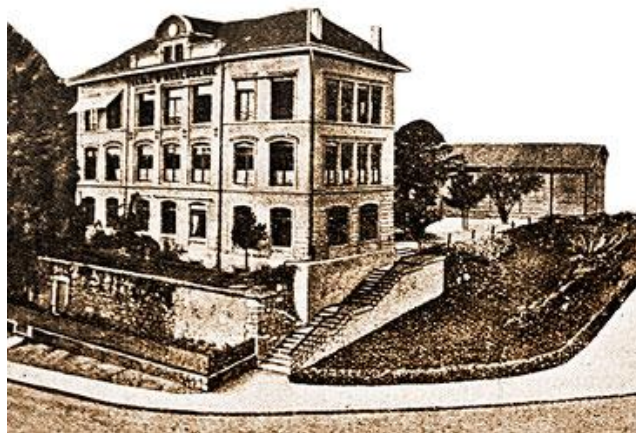


Fig. 6: First dedicated building of the Bienne/Biel watchmaking school built in 1876.

Parts of the 1876 building were also used for municipal administrative services (the water department, for example). Tuition was 30 Swiss Francs per month, at a time when a skilled watchmaker earned 7.50 Francs day, and a 1 kg loaf of bread cost 0.34 Francs

In 1878 an office within the school was created to run tests and issue certificates for the going of two classes of 'ordinary' pocket watches (not chronometers). This was a further, clear indication of the desire to improve the quality of the Biel/Bienne watches. This operation made use of a regulator clock set daily to an electrical time signal from the observatory in Neuchâtel. Later, similar offices were installed in several other Swiss watchmaking schools. These were the direct precursors of the current three COSC (*Contrôle Officiel Suisse des Chronomètres*) laboratories.

In 1883 a mechanical workshop was added to expose students to the machines used in the mechanical manufacture of watches, a development so shockingly revealed to the Swiss watch establishment by American manufacturers at the Philadelphia Centennial Exhibition of 1876. In 1888 a complete five semester curriculum for *Mechanik* (essentially mechanical manufacturing related to the watch industry) was initiated.

In the late 1880s Emile Jämes, the director of the Bienne school from 1886 to 1889, had some thoughts on the educational needs of the 'modern watchmaker' [3]. An interesting sentence, relevant to the topic of this paper states '...the student first fabricates an escapement in a large scale.... [on this model] the teacher can easily demonstrate all functions...' He clearly believes that the making of an escapement model by students was an important part of their training.

In the 1880s the Canton of Bern considered establishing a *Technikum*, which was to be a fairly comprehensive, middle level technical education establishment. Bienne/Biel thought they should be the seat of such an institution and prepared a detailed proposal, but Bern delayed a decision. Biel industrialists and citizens decided to form their own institution in 1890, now called *Westschweizerisches Technikum, Biel*. The official cantonal school was awarded to Burgdorf in 1891, but Bienne/Biel became the second official *Technikum* of the Canton of Bern in 1910. A proper building for the *Westschweizerisches Technikum* was not built until 1900, still on the cemetery grounds. In the meantime, temporary wooden structures were erected behind the original 1876 watchmaking school building. One of the five sections of the *Technikum* grew out of the established watchmaking school. Its curriculum was now expanded to a standard seven semesters of instruction. It also offered some more advanced courses in horology.

The brand new *Westschweizerisches Technikum* is the school J. Schwarzentrub entered in 1890. The *Registre des Elèves* from that time (depicted in [4], p. 315) has apparently been lost [5], but we know that Johann Schwarzentrub (born Johann Mathaeus Schwarzentrub in Grenchen in 1873 [6]) attended the school from 1890 to 1893 [5]. He built his escapement model in 1892.

During Schwarzentrub's attendance, the Bienne watchmaking school was frequented by 29 students in 1890-91, by 34 in 1891-92 and by 32 in 1892-93 [7]. I have no reliable information about how many of these students built an escapement model, nor what escapements were modeled. Director Jämes, who thought making escapement models was important (above), had just left in 1889 for a new position in Geneva. Fallet & Simonin [4] (p. 349/350) show seven models, all made between 1888 and 1905. Four have a cutout in the top plate for the observation of the balance wheel. Five are signed by a student and carry the name of the Bienne school (always in French). One carries the name of the school only, and one is completely unmarked. All are the same size as the Schwarzentrub. Five are Swiss anchor escapements, one a spring detent and one a cylinder escapement. Materials of construction are called out as steel and brass, and some have ruby pallets. German silver (*maillechort*) is not mentioned for any of them, not even for our Schwarzentrub model, which is one of the models depicted, and which has plates made of German silver. I have come across three more Bienne models. One is almost identical to ours, save for the ratchet wheel now being located between the plates and perhaps not having a jewel for the balance pinion. It appeared in a USA auction in 2017 and is signed by Emil Mutschler 1888, with the usual school inscription in French [8] (Fig. 7). Another is by Eugen Fasnacht 1895 held in the *Lycée Technique in Bienne* [3]. It has a cutout for the balance wheel and is of the Swiss anchor type. Another very (likely) similar model is held in the British Museum (Museum Number 1966, 0402.2, no picture available). It was made by Hermann Roost in 1889 and is engraved with the usual French school/maker inscription. It appears to be the same size as all the others. Again, all the 'certified' Bienne escapement models I know of were made between 1888 and 1905. It seems that escapement models were made by students in the Bienne school only for a short period of time.



Fig. 7: A Bienne escapement model made by Emil Mutschler in 1888 [8].

Perhaps the Bienne design of escapement models was adopted by other schools. It is worth noting the four Geneva escapement models depicted in Fallet & Simonin p. 78/79 [4]. They are very reminiscent of the Bienne models. One with a detent escapement is shown in Fig. 8. All

are essentially the same size as the Schwarzentrub, but are made of gold-plated brass. All have balance wheels between the plates but are cut out to be able to observe the balance wheel from the top.



Fig. 8: Detent escapement engraved with *Ecole d'horlogerie de Genève* and *Echappement à Détente*. Musée d'art et d'histoire, Geneva. Inv. Number H 2008-122.

The diameter of the top plate in each is about 4 mm smaller than that of the bottom plate (72 mm), suggesting they might originally have been made with a cylindrical container for safekeeping, or a sleeve of wood or brass between the two plates to give the model a finished appearance. All are said to be 1880-1900, and all are engraved with the name of the Geneva school and the type of the escapement modeled. None of them are engraved with a maker's name. It seems that these models were made by a mechanic or instrument maker for the school's use as instructional models. It is very possible that Emile Jämes, director of the Bienne school, had a hand in the making of these models when he took a new position in the Geneva school in 1889. His declared interest in making escapement models is mentioned above.

Finally I want to mention another model, owned by a collector in the Black Forest. He thinks it is related to the watchmaking school in Furtwangen, and he dates it to 1925 (Fig. 9). It is just about identical to the Schwarzentrub model (including its size and the three feet sticking out from the bottom plate). It is made of gold-plated brass and has metal pallets inserted in the anchor. It is stored in a little brass can covered by a glass plate (now cracked). It is completely unsigned or otherwise marked. Again, it might not be the work of a student, but rather a demonstration model acquired by the school from outside.



Fig. 9: The 'Furtwangen' model virtually identical in size and design to the Schwarzentrub. It is said to date from about 1925. It is stored in a brass can (bottom).

Two Schwarzentrub Watchmakers

The first mention I could find of the name Schwarzentrub in connection with watchmaking in Switzerland is an entry in the *Schweizerisches Handelsamtsblatt* [10,11], reporting that Eduard Kummer, Johann Schwarzentrub, and Peter Obrecht (all of the city of Grenchen) formed a

Kollektivgesellschaft (simple partnership) under the name P. Obrecht & Cie on January 4, 1883. There is interesting background information on this partnership in the memoirs of Peter Obrecht's sister Lina [12]. She recounts that the two watchmakers Kummer and Schwarzentrub, who were previously *visiteurs* [9] in the watchmaking business of Adolf Girard, had formed a partnership with each other, operating from a small factory in Grenchen. They approached Peter Obrecht to form a new partnership with them in order to enlarge their operation. Obrecht was a prominent Grenchen conservative catholic, trained watchmaker, farmer, mayor of Grenchen, founder of a savings and loan bank and a building society. He was obviously a good choice as a partner. A substantial portion of the watchmaking business in the town in Grenchen was already in the hands of the families of Girard, Schild and Obrecht. All were heavily invested in the manufacture of *ébauches* [13]. The three families were all related by judicious marriages.

After some hesitation, Obrecht agreed to a partnership with Kummer and Schwarzentrub and put up fifty thousand Francs. Lina Obrecht recalls that the intent was to build a complete, mechanized watch factory after the 'American example'. Likely they intended to produce watches of some quality. This did not materialize. After 1891 they produced only Roskopf movements [14] in very large numbers (footnote in the introduction to the memoirs [12]). Kummer and Schwarzentrub were to be the technical brains behind the operation, while Peter Obrecht (and his young son and later partner, Adolf) were in charge of the business side. According to Lina Obrecht the firm eventually grew to more than two hundred workers. There were apparently regular quarrels among the three partners. Kummer left the partnership in February 1888 and formed his own *ébauche* factory in nearby Bettlach. Johann Schwarzentrub left in October 1892. He is now listed as Jean Schwarzentrub in the paperwork at that time. Lina Obrecht recalls that Kummer and Schwarzentrub were each paid out the large sum of eighty thousand Francs as their share of the partnership when they left. She was in a position to know, as she was the bookkeeper for many of P. Obrecht's enterprises. After Schwarzentrub left, a partnership of P. Obrecht and his son Adolf (still called P. Obrecht & Cie) continued and ended in bankruptcy in 1922 in one of the big crises the Swiss watch industry suffered.

The Johann (now Jean) Schwarzentrub of this partnership was born Johann Viktor Schwarzentrub on October 2, 1850 as the illegitimate son of Maria Elisabeth Schwarzentrub [6]. He married Maria Katherina Wullimann on April 8, 1872. They had several children. A son baptized Johann Mathaeus Schwarzentrub was born on October 29, 1873 [6]. This is the J. Schwarzentrub who made our escapement model. We recall that he finished the *Ecole d'horlogerie Bienne* in 1893. I have no doubt that Jean Schwarzentrub (father) chose to leave his partnership with Peter Obrecht in October 1892 because he envisioned that his son Johann would join him in their own watch business after completing the watchmaking school in 1893.

Indeed, in October 1893 the Schwarzentrub (father) started a partnership with Arthur Müller in their own, new building on Schützengasse in Grenchen. Thanks to the payout from his

previous partnership with Peter Obrecht he had a good number of Francs to invest in this workshop/small factory. After just a few weeks, in December 1893, Schwarzentrub became the sole owner of the firm. From this time on, his son, no doubt, played the role of a technical director for him, but there is no direct evidence that the son even participated in the firm. I also have no solid evidence of how this firm wanted to position itself in the Grenchen watchmaking industry. My guess is they wanted to produce well-finished anchor watches of some quality, setting themselves apart from the vast production of ébauches [13] in Grenchen, many of them for cheap Roskopf watches [14]. In February 1894 the firm registered two calibers, but I have no technical information on these, nor have I found other information on their production. Schwarzentrub took on Hulda Grünberg from Biel as a new partner from February to September 1896. He may have considered this short-lived partnership merely an infusion of capital. Grünberg's financier husband, Adolf, also participated in the firm (not as a formal partner, however). An enlargement of the Schützengasse facility dates from that time.

Things clearly went downhill from there. The younger Schwarzentrub, the maker of our model, died on April 30, 1897 from an illness. He was less than 24 years old [6].



Fig. 10: A notice published in the local paper *Grenchener Volksblatt* May 5, 1897 by the Jean Schwarzentrub family, thanking the many people who offered their sympathies during the illness and the burial of their unforgettable son and brother Jean Schwarzentrub. Note that the son is now also called Jean, no longer Johann. [15]

Jean Schwarzentrub (father) continued his business activities after the death of his son. From July 1897 to January 1899 he was a partner in the firm of Friedli, Triebold & Cie in Grenchen (premises *not* on Schützengasse). Problems continued. On December 5, 1898 the Jean Schwarzentrub firm was struck from the commercial registry (*Handelsregister*) by the authorities (*von Amteswegen*) because of the insolvency of Jean Schwarzentrub. In the simplest form of organizing firms used by Schwarzentrub, the partners (in this case just Schwarzentrub) were responsible for liabilities of the firm with all their personal assets. These simple firms did

not have their own legal persona. It seems obvious that Jean Schwarzentrub lost his premises on Schützengasse in the course of the bankruptcy proceedings that followed, but the details, while available, have not been researched [16].

This bankruptcy notwithstanding, Jean Schwarzentrub (father) was not done yet. He entered a partnership with Adolphe (or Adolf) Michel in 1901 in Lengnau, moving the operation to Grenchen in 1903 (as Ad. Michel & Cie). They were makers of ébauches. In February 1904 this Ad. Michel & Cie firm was dissolved by agreement between the partners Schwarzentrub and Michel. Schwarzentrub and Emil Obrecht-Hugi (the son of his first partner Peter Obrecht) assumed the assets and liabilities of the dissolved firm. They formed the new partnership Obrecht-Hugi & Cie and continued the fabrication of ébauches.

Jean Schwarzentrub is often named as one of the founders of the firm of Ad. Michel (1906), which was incorporated as A. Michel S.A. in 1918 (S.A. means *Société Anonyme*, i.e. properly constituted share company). This is not correct. Schwarzentrub and Michel parted ways completely and forever with the dissolution in 1904 of their Ad. Michel & Cie partnership. Some of the confusion may arise from the fact that Adolf (or Adolphe) Michel was apparently able to buy Schwarzentrub's original Schützengasse property (likely lost in his 1897 bankruptcy). He listed Schützengasse as the premises of the new Ad. Michel firm in its 1906 registration and in the 1918 registration of A. Michel S.A. This location (with numerous additional land buys over the years) became the site of the large and important Grenchen Michel watch factory [17].

Jean Schwarzentrub (father) died on May 21, 1912 [6].

The author is grateful to Urs Roth (Ins), Stefan Frech (Solothurn) and Elsbeth Adam (his cousin in Oberdorf) for their help with research in Switzerland. Several other Swiss museums and individuals I approached did not even bother to acknowledge my inquiries.

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Addendum

I thought I should add some interesting information I found while researching this paper. It is not directly related to Schwarzentrub or the Bienne school. Some of it is not terribly well known, or has been misinterpreted. This additional information includes ten early escapement models by Antoine Tavan (1805) in Geneva, a series of 28 models made at or for the *Ecole Nationale d'Horlogerie* in Cluses, France (before 1900), four models made for the Furtwangen watchmaking school (1860), and the making of escapement models in Glashütte in Germany by Moritz Grossmann (around 1876) and at the German watchmaking school (1878 to 1951).

The *Musée d'art et d'histoire*, Geneva holds a series of ten escapement models made around 1800 to 1805 by Antoine Tavan (1749-1836). Seven of them still have their wooden, turned containers of about 8.3 cm diameter and 5.4 cm height, labeled on the outside on brass labels

with short names for the type of escapement and/or Tavan's name. Tavan apparently made these ten models (including three of his own invention) for the Geneva manufacturers Melly Frères. A curious type of anchor escapement is shown in Fig 11. It might well be Tavan's own invention. The anchor certainly looks more like a ship's anchor than any other watch anchor I have ever seen. Tavan was also instrumental in the formation in 1824 of the Geneva *Ecole de blancs*, which became the Geneva watchmaking school. This will have to serve as justification for my inclusion of Tavan's models in this paper.



Fig. 11: A model of a curious form of anchor escapement made by Antoine Tavan in 1805. This is one of ten escapement models made by Tavan held in the *Musée d'art et d'histoire* Geneva. Inventory number AD 2550.

Perhaps the most significant surviving collection of school escapement models comes out of the *Ecole Nationale d'Horlogerie de Cluses* in France's Haute-Savoie region, less than 40 km from Geneva. The school was founded in 1848. There are 28 models now held in the *Musée d'Horlogerie et du Décolletage* in Cluses [18]. The models are beautifully photographed and

adequately described (for the most part) on the home page of the museum. Twenty models are said to be from 1880. This is probably not an exact date but simply a placeholder date meaning 'some time before 1900'. Several (perhaps all) were made by students. Some carry tattered paper labels with the printed name of the school and the hand-written name of a student. I do not know under what circumstances these student-made models ended up in the school's possession. Maybe the school acquired especially well-made models for their instructional collection. These twenty models are on (pretty much) standardized wooden bases with gold trim and are normally covered with glass domes. They measure about 20 cm in diameter and are about 25 cm high. The balance wheel and -spring are raised high above the platform and are mounted from a kind of gallows supported by two columns. This arrangement makes it easy to observe the escapement mechanism itself. Many different escapements were modeled, including some in a tourbillion carousel. An example of the typical Cluses design is shown in Fig 12. It is a model of a pin-pallet (Roskopf) escapement.



Fig. 12: Typical arrangement of the *Cluses* escapement models.

This is a model of a pin-pallet (Roskopf) escapement. It is normally covered by a glass dome. Held in the *Musée d'Horlogerie et du Décolletage*, Cluses (France). Inv. No. D 2014-00-0240.

Seven additional models, also held in the Cluses museum, were all made by Léon Vareilles in 1896. They are smaller (14 cm diameter, 16 cm high), but continue the general arrangement of the previous twenty models. Curiously, there is only one standard Swiss anchor escapement in the collection of the museum. Inventory number D 2014.00.0241, however, stands out like a sore thumb from the other twenty-seven models. This is because it is a 20th or 21st century replica made in China in the style of a Glashütte model. It is not declared as such by the museum.

Another interesting series of four models was made (or ordered to be made) in about 1860

by J.H. Martens, a teacher at the important German watchmaking school in Furtwangen (Baden). He is the author of a treatise on 'advanced' escapements [19]. There are models in that series of a cylinder, an anchor, a duplex and a chronometer escapement. They are built on single brass plates.

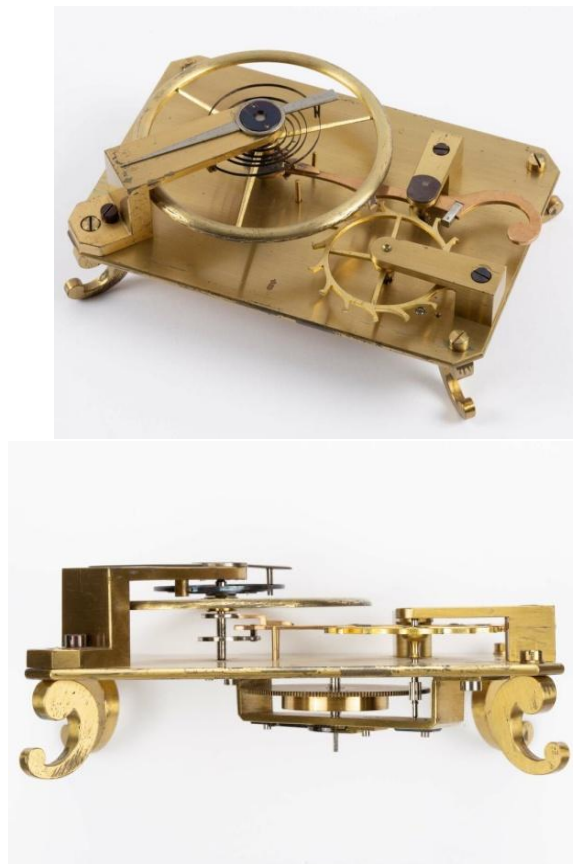


Fig. 13: An anchor escapement model made about 1860 for the Furtwangen watchmaking school. It is built on a single 145 by 100 (mm) brass plate. Held in the *Deutsches Uhrenmuseum* in Furtwangen. Inv. No 41-0188.

A simple spring drive couples directly to the escapement wheel. Pictures of the other models in this series are readily found by googling 'Furtwangen Gangmodell'. I suspect these models were the template for the smaller '30 minute' models Moritz Grossman sold a few years later (below).

Karl Moritz Grossmann (1826-1885) was an extremely well educated horologist, who spoke several languages. After years of travels and studies all over Europe and two periods of military service as a volunteer, as well as a position as *visiteur* [9] in La Chaux-de-Fonds in Switzerland, he settled in Glashütte in 1854. He became known as a maker and seller of fine shop and measurement tools (which included the early use in Germany of metric scales). He also became a maker of typical Glashütte pocket watches and was involved in work on the one-second

pendulum standing clock with his employee Ludwig Strasser. His was a prolific writer. His famous treatise on the detached lever escapement won a First Prize from the British Horological Institute in 1865. He wrote the Prize Essay in English, and in 1866 he had a much expanded version (doubled in size) printed in Leipzig at his own expense (still in English). This was followed by his own French and German translations, also in 1866. I have not seen a competent discussion of the relative merits of Martens' book [19] (dealing with all advanced escapements) and Grossmann's expanded Prize Essay (dealing only with the anchor escapement). In many sections the similarities are striking. Grossmann was certainly aware of Martens' 1858 book when he submitted his Prize Essay in 1865, but he does not mention it at all. I have done a search of the 1866 expanded first edition of the Prize Essay, and the word 'Martens' does not appear in it. Grossmann is listed in Martens' book as its seller in Glashütte. Apparently they also met during their military careers in the German-Danish wars.

Grossmann also does not mention escapement models even in the enlarged version of his Prize Essay of 1866. In the advertising section of the book there is no mention of escapement models among all the many products offered for sale in his shop. At the latest from 1876 we know that he was a commercial seller of complete models and all parts needed to construct escapement models. In an 1876 article *Gangmodelle, eine lehrreiche Arbeit für Lehrlinge* [20] (about: [Building] escapement models: an instructive activity for apprentices) he offered to sell to his watchmaker colleagues all the parts needed for their apprentices to build escapement models of all known types. He also sold and rented out finished models to the trade. In another 1876 notice in a trade journal [20] he gives more details on these complete models (all requiring several weeks of lead time for manufacturing). A first type (all common escapements) was built on a single 85 by 75 (mm) brass plate with a 60 mm diameter balance wheel. The plate was supported on four small feet. Under the plate there was a small spring providing for only about 30 minutes of operation on one winding. He recommends these small models as demonstration objects not just for schools, but also for watch shops to enable a watchmaker to demonstrate the differences between the various escapements (for example between cylinder and anchor escapements) to curious or undecided customers. I have not seen one of these Grossmann '30 minute' models, but from his description one might reasonably assume they were smaller versions of the Martens-Furtwangen models (Fig. 13).

A second type of complete models Grossmann offered for sale were larger models of all common types. They were built on two 120 mm diameter brass plates. They were designed primarily as showpieces for shop counters and display windows. This required a full day (ten hours) of running time on one winding. I think I have identified a finished exhibition model of this '10 hour' variety supplied by Grossmann [21] (Fig. 14). Note that the power parts (spring barrel and transmission to the escape wheel) are located between the two round plates. The huge balance wheel is located on top of the rollers. This location of the balance wheel, also used in the '30 minute' demonstration models and the Martens-Furtwangen models (Fig. 13)

effectively prevents close inspection of the action of the escapement. This arrangement is hypnotic to watch in motion, but it is of limited use as a demonstration or instructional model.



Fig. 14: Swiss anchor model signed 'Großmann Nr. 7349' [21].

The loose placement of this model on top of a turned base in this particular model is of no significance. Grossmann shipped these models to customers routinely without a base and without a glass dome (fearing breakage). Customers supplied their own.

When a newly founded professional association (*Centralverband Deutscher Uhrmacher*) voted to establish a watchmaking school in Glashütte, in no small part at Grossmann's urging, they sent Grossmann on a trip to Switzerland and France in 1877 to inform himself of the state of the art in watchmaking schools. I suspect Grossmann (as a savvy businessman) also took the occasion to peddle his models and to preach the importance of making a *Gangmodell* by apprentices of watchmaking. Apparently without much success. The Grossmann style of model with the large balance wheel on top of everything did not migrate to any of the French or Swiss schools. During that trip he also visited the school in Bienne. Perhaps he at least convinced the schools he visited of the importance of escapement models in the education of horology students. Still, Bienne seems to be the only Swiss school in which models were made by students in some numbers around the turn of the century (see above).

When the school was opened as *Deutsche Uhrmacherschule, Glashütte* in 1878 Grossmann became the Chair of its Governing Board (*Vorsitzender des Aufsichtsrates*) representing its sponsors, the *Centralverband Deutscher Uhrmacher*. He held this position until his sudden death in 1885. Not surprisingly, the size and style of his '10 hour' escapement model were adopted by the Glashütte school [22]. In the school-made models the bottom plate is always sunk into a wooden base, and the clockwork mechanism becomes invisible. Only the top plate with the escapement parts and the balance wheel on top of everything remain visible.

The fabrication of an anchor escapement model became a standard part of the early (1st year) training of students in Glashütte [22]. Models of more complex escapements (chronometer and others) were made by more advanced students later in their training, still using the same template for the overall design. The school codified the detailed technical design of the anchor escapement models made as *Schülerarbeiten* (student projects) at the latest in the 1920s. The design is documented fully in the first volume of the 'textbook' written by teachers at the school [22]. A photograph in the book shows the semi-finished parts used for the model, which were produced in quantity by the *Feinmechanik* section of the school. Detailed step by step instructions are given for the construction of the model.

The huge balance wheel on and the large bridges supporting it remained a feature of all Glashütte watchmaking school models. The wooden base (always used in student work) remained almost without exception in its round, stepped form until it was succeeded (predominantly) by a new square form in about 1935 [22, 23] (Fig. 15). This change was entirely cosmetic. For anchor models all mechanical parts and their mutual arrangement remained unchanged from the 1928 description [22] until 1951 [23], which marks the end of the *Deutsche Uhrmacherschule, Glashütte*.

As an objective Swiss (!) I must think that the Bienne design (exemplified by the Schwarzentrub model of this paper) is superior to Grossmann's, both as a study and as a display object. The Bienne style allows unobstructed observation of the escapement. It is of reasonable size and a pretty rugged model. The motion of the balance wheel can still be observed by looking between the plates from the outside. Whether the Bienne type model is placed loosely on a wooden base under a glass dome (such as the Schwarzentrub now is), or just placed on its three feet on a counter or workbench, it can easily be picked up by one hand for a closer look or for winding. Picking up and turning over the Glashütte Lommatzsch model (Fig. 15) for winding is basically a two hand exercise because of its size and weight.



Fig. 15: A square design, very late (1950) *Gangmodell* of the Glashütte school by Horst Lommatzsch (school registry number 4358) [23].

In addition to developing the mechanical skills of a student during the construction of an anchor model early in his studies, operating and observing his or her finished anchor escapement model provided a first understanding of the essence of an escapement. Moreover, the finished model became (hopefully) an exhibition piece that would be the pride of the future watchmaker [22]. The aspect of creating a coveted display model is underscored by the practice of leaving the decorative finish (level of engraving, gold plating, lacquering, type of wood for base, etc.) to the individual (and the size of his, or his father's pocket book) [22].

In Glashütte many types of *Schülerarbeiten* were made. In addition to escapement models this included pocket watches, pendulum clocks, marine chronometers, micrometers, and other items. Detailed records claim that 422 anchor escapement models were made between 1882 and 1951 [22]. There were also perhaps 150 models with chronometer escapements. The tables list only about twelve escapement models made between 1882 and 1890 (one with an anchor escapement in 1885, two with a cylinder escapement, also in 1885, and eight or nine with chronometer escapements). However, there is a report by an 1879 visitor to Glashütte, claiming he was shown 'two dozen' student made escapement models by the director of the school [24]. I am not certain of this information, nor of that in Herkner's tables. Herkner certainly had access to all the extensive school records after WWII when he wrote his book [22, 23]. We

must remember that Herkner's tables only start in 1882. Obviously, two dozen models made by 1879 would not show up. Moreover, all models up to 1882 became the property of the school, which intended to sell them to help finance the operation of the school. There are apparently no records of these early, 'confiscated' models, and I have not seen one in an auction or a museum. Possibly the school truly started out in 1878 with every student making an anchor escapement model in his or her first year. We assume that Grossmann's workshop supplied the parts, since he already sold them to the trade. After Grossmann's death in 1885, there may have been a lull in making models because of the unavailability of parts until the *Feinmechanik* shop of the school started to make semi-finished parts for models after 1890. Herkner's tables indeed show large numbers of models made after that date, but the numbers are still not large enough to imply that each student made an anchor model.

One of the very early (1888) Glashütte school chronometer escapement models appeared in a recent auction [12](Fig. 16). The similarity to Grossmann's commercial model in Fig. 14 is obvious.



Fig. 16: A very early Glashütte school chronometer escapement model engraved with the name of the school and the name of the maker, Max Peters 1888 [21].

Notes and References

- [1] Acquired by the author in September 2022 on the German eBay auction site.
- [2] German silver, maillechort, Neusilber, Argentan are some of the names used for alloys developed in the 19th century as cheap replacements for silver. To some extent these alloys have the look of silver, while costing only a fraction. They contain no silver at all, but rather varying amounts of copper, zinc and nickel. They were widely used in jewelry, cutlery and in the watch industry (notably for cases). The noble watch brand A. Lange und Söhne still distinguishes itself by making structural parts of movements from German silver. The alloys are machineable, stiff and develop a thin layer of corrosion resistant oxide within a short time after machining or polishing. This oxide layer sometimes gives parts made from German silver a slight golden or yellow hue.
- [3] A full history of the school and its many re-incarnations and name changes can be found here (in German): www.bbz-cfp.ch/upload/geschichte/150_J_US_Biel-Anhang.pdf
- [4] Estelle Fallet & Antoine Simonin, Eds., *Dix écoles d'horlogerie Suisses. Chefs-d'oeuvre de savoir-faire*, Editions Simonin, Neuchâtel, 2010.
- [5] Communication in June of 2023 from Daniel Dietz of the *Lycée Technique Bienne* to Urs Roth. Daniel Dietz took Johann Schwarzentrub's years at the school from an annual report of the *Westschweizerisches Technikum*. The *Lycée Technique Bienne* (or in German: *Technische Fachschule Biel*) is the legitimate successor to the original *Ecole d'horlogerie Bienne*. [3]
- [6] Johann Mathaeus Schwarzentrub's birth name and date (October 29, 1873) were first communicated to me by Urs Roth in June 2023 based on his research at the *Staatsarchiv Solothurn*. Life data for both Schwarzentrub father and son have also been found on the genealogy websites www.familysearch.com and www.myheritage.com
- [7] Fernand Schwab, *Die industrielle Entwicklung der Stadt Biel*, Dissertation, Law School, University of Berne, printed in Biel, 1918. The student attendance numbers are based on the annual reports of the *Westschweizerisches Technikum*.
- [8] Schmitt Horan Auction, New Hampshire, USA, April 29/30, 2017, Lot 700.
- [9] A *visiteur* was an examiner in a watch factory, essentially in charge of quality assurance..

[10] The official publication *Schweizerisches Handelsamtsblatt* is an incredibly valuable resource for the commercial history of all of Switzerland. Starting in 1883, and continuing to the present, it contains short abstracts of all reportable activities relating to commercial entities from tiny shops (including bakeries, butchers) to major corporations alike. These abstracts are based on the original entries in the *Handelsregister* of all the many local registry districts (several per Canton). For the history of businesses mentioned in this paper we will not refer to the dates of entries in the *Schweizerisches Handelsamtsblatt*, but quote instead the dates of the original entries in the *Handelsregister* of the relevant registry district.

[11] The library of the Swiss Federal Institute of Technology (ETH) in Zurich has scanned more than 10 million pages of Swiss periodicals. They can be searched 'full text' online, but I found this requires patience and skill. Access: www.e-periodica.ch

[12] F. Saner & K. Reinhardt, '*Memoiren einer alten Jungfer: die Aufzeichnungen der Grenchnerin Lina Obrecht (1856-1936)*', *Jahrbuch der Solothurner Geschichte*, Volume 89 (2016). Available on e-periodica.ch [11].

[13] Ebauches were the bread and butter of the Grenchen watch industry. An *ébauche* ('blank canvas' in art) in the 19th century denoted the assembled basic structural components of a watch movement, including plates, bridges and cocks. Later, the term also included wheels and today it means a complete movement fresh from a factory.

[14] The German/Swiss watchmaker Georg Frédéric Roskopf (1813-1889) had a goal of producing a watch that could be sold for 20 Francs (the weekly pay of an industrial worker). He succeeded in 1867 by reducing the parts count of the movement and perfecting a (previously known) escapement. It replaced the precise angles required on the anchor pallets of a traditional Swiss anchor escapement with pins on the anchor set at right angles to the plane of the escape wheel (pin-pallet escapement). He also used German silver [2] for the cases to reduce cost. His watches were moderately accurate but suffered from wear and had a short life. The 'Roskopf' was almost a throw-away watch. Still, *La prolétaire* was made in huge numbers. The Swiss initially turned up their noses at the Roskopf watch, and the first few thousand movements had to be sourced in France. But the Swiss (especially the Grenchen manufacturers) soon saw a large, new business opportunity and put their pride aside. Switzerland did not have a patent system until 1888. This made it possible to pirate Roskopf's designs. However, there were trademarks registered to Roskopf. To circumvent these, and to export watches to countries in which Roskopf had patent protection (France, Belgium, USA), pirated watches were sold under creatively modified names, such as Roskopf, or Système Roskopf, or with various

initials before the Roskopf or Rosskopf name. It is believed that millions of Roskopf watches were exported from Switzerland until the 1970's when the quartz era hit, quickly ending not only the manufacture of Roskopf and other inexpensive mechanical watches, but plunging the Swiss watch industry in general into a deep crisis..

[15] This *Danksagung* notice of May 5, 1897 underpins the previous finding that the death of Jean Schwarzentrub (son) occurred on April 30, 1897 [6]. This image was provided by Dr. phil. Stefan Frech, *Staatsarchivar des Kantons Solothurn*.

[16] The insolvency proceedings were apparently very extensive. I have seen the cover sheet of the paperwork (provided by Stefan Frech), indicating a start on 21 November 1898 and a completion on 20 July 1899. A handwritten subtitle on the cover states *Nachlassvertrag*. To me this indicates that the assets of his deceased son, which likely passed, or were to be passed to the father, were also the subject of the proceedings. A lawyer conversant in Swiss law of the end of the 19th century needs to look at the details. They are found in the papers of the *Konkursamt Grenchen, Band 13, Nr. 15, Zwangsvollstreckungen*, held in the *Staatsarchiv Solothurn*.

[17] Urs Roth has researched the history of the significant Michel watch factory in Grenchen. In detail he reports on their land acquisitions around Schwarzentrub's original Schützengasse site as the firm grew to prominence. See: www.amsagrenchen.com.

[18] Access: www.musee.2ccam.fr/musee-horlogerie-decolletage/
If you are tempted to Google 'échappements Cluses' instead, you will see a listing of the car exhaust shops in Cluses.

[19] J.H. Martens (1826-1882) was a teacher at the Furtwangen watchmaking school from 1858-1860 (or 1863). The school started in 1850, but was closed between 1864 and 1877 apparently because the authorities thought that the school was no longer needed in view of the booming Black Forest clock and watch industry. From 1867 Martens ran a successful upscale pocket watch business in nearby Freiburg im Breisgau. In 1857/58 he wrote the book *J.H. Martens, Beschreibung der Hemmungen der höheren Uhrmacherkunst*. (Vol. 1, text, 248 pages, Furtwangen, 1858. Vol. 2, Atlas, 24 engravings, La Chaux-de-Fonds, 1857). Both volumes have been digitized for the internet, and there are reprints. Martens' book is an unbelievably complete description of the major advanced escapements of the time. It includes not only geometrical features and mathematical analysis, but also offers details on materials (including oils and stones) and metallurgical procedures, as well as fabrication techniques for wheels and other parts. Martens also discusses and recommends the 'new French system' of measurement and describes tools based on this system. However, he does

not offer to make or sell such instruments. The later 'Prize Essay' by Grossmann (see text) has an eerie similarity to Martens' book in many parts. I do not think escapement models are mentioned in Martens' book.

[20] I have not actually seen the article by Grossmann advocating the use of escapement models in the training of apprentices. A Synopsis is given in Kurt Herkner's first book *Glashütte und seine Uhren* (1978), p. 192. A second notice in *Allegemeines Journal der Uhrmacherkunst*, May 15, 1876, p. 101 details the two types of finished models Grossmann offered for sale to schools and the trade. It includes prices. The '10 hour' models cost 15 Mark more than the corresponding '30 minute' models, which sold for 24 to 56 Mark depending on the type of escapement modeled.

[21] Galerie + Auktionshaus Peter Klöter, Grafenau, Germany.
Grossman Nr 7349: Auktion 187, July 11, 2020, Lot 561.
Max Peters' chronometer escapement model of 1888: Auktion 197, Nov. 4, 2023, Lot 619.

[22] Kurt Herkner, *Deutsche Uhrmacherschule Glashütte – Geschichte der Schule*, Herkner Verlag GmbH, Dormagen, West Germany, 1985. This is hardly a history of the German watchmaking school in Glashütte. The school history is 'told' only on pages A1 to A63 with very tiny, unreadable reprints of some documents and pretty pictures of student projects and other items. The most valuable feature, by far, is a table on pp. A16 - A18, viz. an analysis of student projects by 'school number' and year from 1882 to 1951. We have analyzed this table and verified it with about 60 known student projects with known school number and year of creation [23]. The book also contains a verbatim reprint of: L. Schreck, O. Hesse and A. Helwig, *Die Lehre an der Deutschen Uhrmacherschule zu Glashütte/Sachsen, Band I bis III*, Verlag der Deutschen Uhrmacher-Zeitung, Berlin 1928-1931. Volume 1, pages 114-150 contains the detailed description of the work to be undertaken by a student to make a complete anchor escapement model. According to this book, an anchor model was made by students in the 6th through the 8th months of the first year of their studies. This is much earlier than the second or third year of Johann Schwarzentrub's attendance at the Bienne school during which he presumably made his model. Perhaps Schwarzentrub's model was a kind of afterthought rather than a work made in the regular course of his studies. He may simply have wanted to make a display model for use in his business endeavors after leaving the Bienne school.

[23] Paul Zoller, 'A Late Glashütte Watchmaking School Escapement Model', November 2021, unpublished, but available from this author as a .pdf file. A detailed comparison was made of the technical details of this model and the description in the textbook [22]. They are identical, except, of course, for the square top plate of this model (Fig. 15).

{24} This report of a visit to Glashütte supposedly appeared in *Allgemeines Journal der Uhrmacherskunst (?)* on October 11, 1879. It is transcribed by K. Herkner in *Glashütte und seine Uhren* (1978), p. 315.

Appendix

The Nature of Escapements

An escapement is the central feature of any mechanical watch. Its function is two-fold. First, the spring-driven escape wheel parcels out the impulse needed to keep the timing element of the watch (the balance wheel) operating at a constant 'swing' (repetition) rate and, second, its intermittent motion at intervals dictated by the balance wheel sets in motion the wheels of the watch to advance the hands.

Dozens of escapement designs have been proposed over the centuries. The most significant (at different times) go by such names as verge, detent, cylinder, duplex, English lever, pin lever (Roskopf), and Swiss lever escapement. From first quarter of the 19th century the Swiss lever (or anchor) escapement started its ascent in quality watches. In its well established 'standard' form it continues to be dominant in mechanical watches in the present day. Developments in mechanical escapements, however, have continued with refined Swiss lever escapements, such as Rolex's Chronergy, or radically new commercializations, such as Omega's (Daniels') co-axial escapement. These are found exclusively in expensive watches. The success of the Swiss lever escapement can be ascribed to its many features one would always seek in an escapement: reasonable cost of manufacturing, good time keeping, self-starting ability, longevity, ruggedness (e.g. insensitivity to a jolt), etc.

The following is an introduction to the Swiss anchor escapement for non-horologists. Figure A1 is a realistic view of a typical escapement. The similarity to the Schwarzentrub escapement model is obvious. The main difference is that the drawing shows stone pallets (red) set into the anchor, whereas the Schwarzentrub escapement model has a solid anchor with forks machined to obtain the angles on the 'pallets' required for operation. The balance wheel is attached to the balance staff (No. 1). In our model it is placed below the two rollers (3 and 4) and between a top and bottom plate. The escape pinion (13) in our model is also between the two plates.

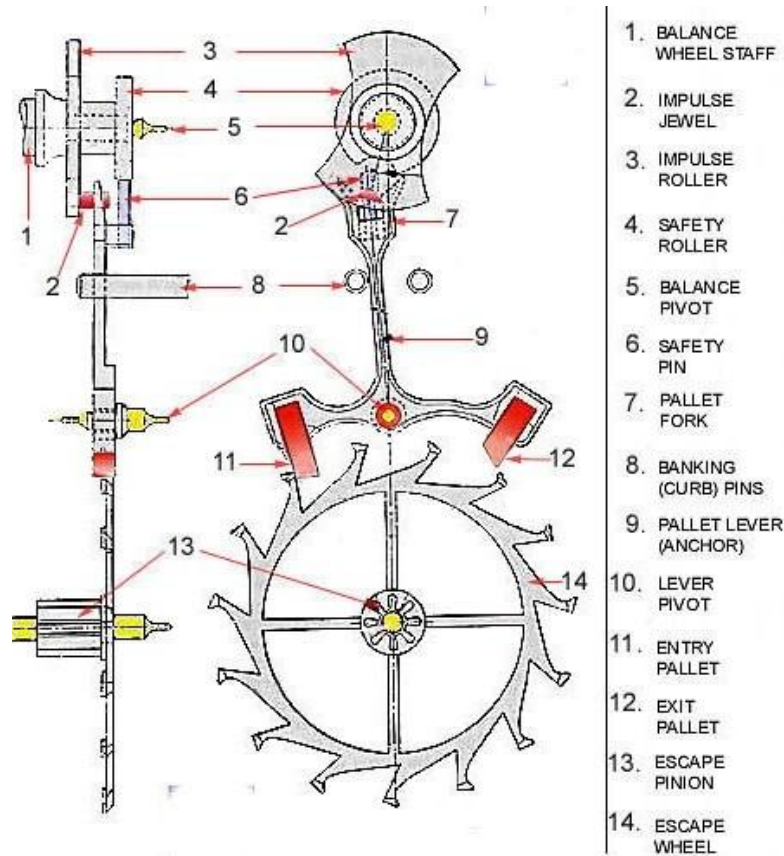


Fig. A1: Parts of a Swiss anchor (or lever) escapement

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The escapement has three main parts: The escape wheel, the pallet assembly, and the rollers. Power from the mainspring turns the escape wheel clockwise while the rotation of the balance wheel turns the rollers, which are on the balance staff. In **Fig. A**, the escape wheel is locked on the receiving stone. Nothing is moving except the balance, which is turning counter-clock wise, as indicated by the arrow. (The balance and hairspring are not shown because they would block the View of the fork and roller action.) The roller jewel is approaching the fork. In **Fig. B**, the roller jewel has entered the fork slot and struck its far side, putting the fork lever into motion. This pulls up one arm of the pallet and also causes the escape Wheel to back up slightly or recoil. The pallet stone slides on the corner of the escape wheel tooth until the corner of the tooth passes the corner of the escape wheel. This releases the escape wheel. Power from the mainspring now drives the freed escape wheel clockwise. As it turns, the tooth of the escape wheel slides on the impulse face of the pallet stone and kicks it up out of the way, driving the pallet arm higher, **Fig. C**. This speeds the movement of the fork compared to the speed of the roller jewel. The fork strikes the jewel from behind and gives it a shove. This gives the impulse to the balance which continues to turn, causing the hairspring to contract or wind up. As the escape wheel tooth slides off the

impulse face of the pallet stone, the wheel turns freely for a short distance. This phase is known as the drop. When the impulse forces up the receiving arm of the pallet, it also forces the discharging arm of the pallet to move down and halt another tooth on the discharging stone. This phase is called lock, **Fig. D**. After halting the tooth, a force called draw causes the stone to move further into the wheel. This movement after the lock is called slide, **Fig E**. With the escape wheel locked, the roller jewel, carried by the balance, swings free of the fork slot and continues to move counter-clockwise until it is stopped by the contracting hairspring. At this point it reverses direction and the same sequence begins again going the other way.

