Early 16 s Hamilton (1895 to 1911)

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I have made a study of the physical characteristics of Hamilton 16s watches from 1895 to 1911 (and beyond). This is the period where Hamilton was "finding its way" and established itself as the dominant force in railroad grade watches.

From the very beginning, it is clear from detailed examination and restoration that Hamilton adopted the newest technology and even pioneered some precision manufacturing practices. Hamilton experimented with two different 16s movements: the bridge (960 series which was short lived) and the now familiar ¾ plate design.

It is unclear why the bridge design was abandoned but it was used later in the 950, 952, 954 and the 994. This may have been done to use up stock. But, most of the parts in the bridge models interchanged with parts used in the 974.

The ¾ plate as used in the ubiquitous 992 is an example of the ¾ plate design.

From 1896 onward, the ¾ plate movements were based on the lowly 974. Excluding the 4974B, 992B, 950B as not true derivatives of their namesake (Hamilton stated they were completely new designs and most parts do not interchange), the 974 is the longest lived movement in the Hamilton catalog.

If a jewel was subtracted, the 974 became a 976. Using gold balance screws and adding the time required for the adjustment to position (approx 3 months) it became the 972. Make the 972 21 jewels and add a double roller escapement and it became the 970. In 1912, adding the time required to adjust the 974 and change it into the 978. Put the 974 in a factory case it it became the 956. Put the 972 in a factory case and it became the 954.

In 1902, lever setting replaced the pendant setting of the 970 and which became the 990. The single roller version of the 990 was the 992. Several years later, the 992 was also given a double roller escapement and the 990 was dropped. Thus, the iconic Rail Road watch, the Hamilton 992 was born.

The first 20,000 or so Hamilton 16 size watches were **all** pendant set. It is not currently known why Henry Cain (designer and Hamilton Co-founder) used the pendant setting mechanism over the lever setting mechanism. Certainly, it required additional engineering, tool making and assembly time.

It is not often understood that these pendant set Hamilton 16 size watches were Rail Road approved watches. Requirements such as lever setting and open face were not established until around 1907. But watches already in service were generally grandfathered in.

Perhaps the reason why Cain chose the pendant setting mechanism was that it offered some distinct advantages over lever setting. With a lever set watch, the bezel must be removed. This exposes the

hands and dial to damage and unintentional misalignment of the hands. It also provides an opportunity for the entry of dust and dirt. Workers using railroad wathces were exposed to everything from coal dust and smoke to sawdust.

The Hamilton catalog of 1929 offered only the 950, 992 and the 974; open face lever set only.

One of the most notable aspects of Hamilton's manufacturing process and innovation, was the absolute conservation of effort when it came to fitting out these movements. With the exception of the escape wheel (brass in 974 and 976; steel in all others), and things like gold wheels, virtually any part made for the 974 could wind up in any of the models.

This includes balance staff, balance wheel, screws, unset jewels, motion work, setting parts, mainspring and winding, pinions and wheels. This means that only one library of tooling was needed. That is an economy that most companies did not enjoy.

It also eased the whole distribution and after market service network. Where it was often required to order parts by serial number for other makers, the part could simply be ordered or pulled by part number. There was some variation by model (pivot and hole jewel size) which limits this generalization.

This was a result of Hamilton's commitment to ensuring tolerances were controlled to a very high degree. This required monitoring of tooling and quality assurance methods that were ahead of their time.

I have used jewels from a 1912 974 to replace cracked jewels in a 1902 972. This includes lower third, fourth and center wheel jewels in various situations. An upper hole jewel can be replaced with another and result in perfect end shake. This is true with other set jewels I have replaced.

That means the Hamilton controlled tolerances not only across runs, but across years!
All of this means that Hamilton could price its watches based on perceived value, not actual manufacturing effort.

The time to produce the parts and assemble the watch were no different among a 972 and a 974. Throughout their life cycles, the had the same escapement. (There were two, the poised single roller and the later simple lever).

The only real difference was that in the early years, the 974 used a brass escape wheel and the 972 received a steel escape wheel with oil retention groove. The 972 also received a heavier balance using gold screws and stiffer balance spring to facilitate timing to position.

The 976 was a 974 missing the lower center wheel jewel.

The 1918 catalog shows the 978 (adjusted to 3 positions) costing $2 more than the 974 ($17) (unadjusted). The 972 cost $24 (or 20% more than the 978) and the 970 costs $34 (142% the cost of

the 972). Both the 972 and 970 required the same amount of time in the adjustment department. The adjustment to both the 972 and 970 is the same.

So, the time used to go from unadjusted (974) to 3 adjustments (978) is represented by $2. In my experience, once the first three adjustments are completed, the remaining two are found in short order.

To go from the 978 to the 972 (3 to 5 adjustments) resulted in a 26% premium when the added costs of gold balance screws and settings was minor (low carat and fixed gold price). To go from a 972 to 970 resulted in a 42% premium when both watches used the same balance and overall finish. The 970 did include a double roller escapement with two extra cap jewels.

Catalog prices of parts do not explain these difference either.

What this means is that Hamilton could price their watches at very favorable profits. And a profitable business could be very generous with customer service. Whether it was in warranty work or in special orders.

In fact, little attention has been paid to the role of Hamilton's "Non- Retailing" operation that shows up in the finishing records. This appears to be a Hamilton controlled entity that occasionally received finished watches with no record of where those watches went. It is listed in the records as being in Lancaster, PA.

And we know that there are many watch configurations that were not offered in the catalog, from the private label watches to custom ordered watches (such as a 992B ordered with a Roman figure dial). We also know of 3 Hamilton 993 (hunting case) watches produced around 1920 (the 30th anniversary of Hamilton's incorporation) that were housed in Hamilton Factory cases.

Neither of these last two watches appear in any Hamilton catalog which demonstrates the limitations of relying on the catalogs alone for verification. In the first case, the 992B showed up in a note in the Hamilton archives. In the second instance, the watches themselves are in the hands of collectors. The cases have been verified as authentic by one of the few remaining case repairmen in the USA who has confirmed he has seen other examples of these cases.

Speaking or records, Mr. Lowell Halligan was a VP at Hamilton in the late 1930s. He complied a history of Hamilton product up until that time. This history is often consulted by collectors. But, Mr. Halligan had little to no documentation on the early Hamilton production and there spots where he admits ambiguity. In other spots, there are contradictions with other Hamilton documentation. This is not to disparage Mr. Halligan's work; indeed it is almost a requirement for serious Hamilton collectors. It was a monumental undertaking and we owe a debt him for leaving behind the best documentation of any American watch company. But like every research source, it is but one of many sources and should be interpreted with judgment.

In the early years, Hamilton not only experimented with bridge and ¾ plate designs (concurrently) they also used designs of components some of which are today seen as modern.

Specifically, up until about 1910, all the steel escape wheels had oil retention grooves at the teeth to keep the oil from migrating. This was abandoned with the introduction of the 952/954 but today it is considered a requirement on very high beat (36,000 BPH) wrist watches.

To Hamilton, a watch movement was a scientific instrument intended to accurately measure intervals of time. It was a working instrument. Their entire process was focused on that.

Hamilton avoided the prestige market. The 950 is their highest grade, but it was adjusted no differently than the other 5 position watches. It does have extra finishing details like the beveled regulator assembly.

Hamilton made its name in the 16 size watch market on the precision railroad watch (970, 972,990,992) and on the 974 which was still a dependable timekeeper but made more for those who did not need precise to the second time.

As a watchmaker, I can attest that many Hamilton Railroad watches can be restored to the original factory performance of 6 seconds per day across the 5 positions. This means that when worn daily, and set to USNO time signals, they will be off by no more than 30 seconds per week if wound every 24 hours. See Watch Adjustment.

This meant that Hamilton finishers (timing dept) needed to be trained in finishing only a few levels of adjusting. This greatly simplified the procedures allowing Hamilton to focus on consistently tight timing (6 seconds a day across 5 positions) without the need to create a masterpiece.

The assembly department only had to be trained on one watch. The tooling department only needed tooling for one watch.

The primary thing that really changed from one grade to another was the material used in making components. The pallet jewel employees only made one style of pallet jewels. The only thing that changed was whether they were grinding white or pink sapphire.

The balance screw department used the same tooling to make either brass or gold balance screws.

The most variation of manufacturing seems to be the balance spring where Hamilton made spring strengths (6 grades of steel springs are listed in the later material catalogs) to accommodate the different balance balance masses used on the two grades of balance assemblies.

This may be a good point to examine the early Hamilton balance assemblies. Perhaps intutitvely, Hamilton made the balance assemblies on the precision grade watches (972 and above) with a higher moment of inertia which required a stiffer balacne spring. In oscillator theory today, this is described as improving the “Q” coefiicient which is a measure of the bandwidth for resonance. Higher “Q” results in a more stable oscillator.

No Hamilton 16s balance I have studied manufactured prior to 1910 has mean time screws used to adjust poise or even bringing the watch to mean time. All screws on these balance assemblies are typical balance mass screws with no provision for adjustment other than the regulator.

Remember, after the manufacturing pipeline was filled with 16 size watches, Hamilton was finishing several thousand per month. The task of bringing a watch to time, without timing washers and screw cutters is seemingly insurmountable. Let alone on a production basis. Then add in the timing across positions.

My hypothesis is that there was some policy/procedure for the intial loading of the balacne with screws to get the approximate moment of inertia and then perhaps a chart to estimate which screws to change to get the desired results. This is precisely what Hamilton did with the M21 40 years later and in fact, Hamilton sold assortments of balance screws.

The answer may be in the archives at the NAWCC Library.

However they did it, it was a very interesting "trick" that is to be admired.

And here is clue to collectors of Hamilton watches made prior to 1910. The balance assembly should have one type (brass or gold) of screws and no mean time screws.

Another component design was that all pallet jewels were radiused along the vertical plane (from 976 to 990 and 992). This was abandoned with the new escapement design introduced with the 952/954. I have been unable to find any information on the benefits of radiused pallet jewels.

Another feature of the early watches shows commitment to timing excellence and parsimonious use of tooling and parts inventory. Up until the escapement redesign, all watches used a poised lever assembly for the pallet fork. This was composed of a counterweight (mustache) to counterbalance the weight of the fork and its jewels.

This was abandoned upon the realization that inertia is far more important in the action of the escapement. The increased mass of the mustache resulted in increased inertia of the pallet assembly and required more power and more time to respond.

The assembly of this shows Hamilton's simplification of the manufacturing process. The poised pallet assembly was composed of 6 parts. The 2 pallet jewels, the pallet frame, the counter poise w/ impulse slot, the dart and the staff. The jewels could pink or white sapphire (white to 972 and above), a single design of pallet frame, a single design of counter weight and two designs of safety dart (single roller and double roller). Either dart could be fitted to the impulse slot end of the counter weight. There were two designs of pallet staff Single roller/17 jewel and Double roller/21 Jewel.

The six component parts could be combined very quickly to make a double roller or single roller escapement poised pallet assembly.

In 1911 Hamilton redesigned the escapement to the familiar escapement today with the simple pallet assembly.

These observations reveal Hamilton's well thought out and deliberate approach to manufacturing, inventory management and distribution. Parts ordering was simplified. In a pinch, a watchmaker could substitute parts from another grade to enable the watch to function until the proper part arrived. Hamilton's tooling, assembly and finishing departments essentially had only 16 size watch to be concerned with.

It is interesting to note, that other than a brief interlude with the 976, Hamilton eschewed the low end of the market. It seems they wanted to project the image of consistent accuracy.

Hamilton could focus on consistent product quality while pricing watches at favorable profits.

It is my opinion that these are significant factors that explain why Hamilton, in 15 very short years, became the juggernaut of precision watches.

Order of Introduction of Hamilton 16 size movements.

This list was compiled using the Hamilton Grade Catalog compiled by the National Association of Watch and Clock Collectors, a very important organization for collectors.

The NAWCC catalog provides the year a model first went through the Hamilton Finishing Dept (the last step) and the starting serial number of that model. Using this list, it is possible to list Hamilton watch models in the order in which production was planned.

It is important to remember Hamilton preassigned serial number blocks to models and runs. For example, this explains the high serial numbers of their 18 s movements when compared to the 16 size movement serial numbers finished in the same year.

Four groups jump out. There is a mixed group of bridge and ¾ plate models introduced in the first 3,500 hundred movements. This includes all of the 960 series (bridge model) and the 972 through 977 series. The 960 (bridge design)as the first 16s movement planned (s/n 50001) and the first ¾ plate movement planned was the 972 (s/n 52011). As noted elsewhere, the early bridge model was abandoned in relatively short order in favor of the ¾ plate model exemplified by the Hamilton 992.

The second group covers the years of 1901 to 1905.

The 970/971 (still using pendant set) was planned (s/n 70201/71201) and went through the Finishing Department in 1901. These were the last of the Hamilton watches designed to use the positive pendant setting mechanism until WWII.

Lever set watches were introduced by Hamilton in 1903 with the 990 (s/n 302001) and 992 (s/n 302101). The 990 used the Double Roller escapement and is functionally a lever set 970. The 992 was introduced as a lower cost alternative to the 990 and used the Single Roller escapement upon introduction.

Within a few years, the 992 was fitted solely with the Double Roller and displaced the 990. There was a period of mixed runs in the 992 until around 1906.

The third group of watch models is represent by the 950 series. The 19J 952 (s/n 750701) the 23 J 950 (s/n 775501) and the 17J 954 (797201). The first two were new designs using a motor barrel. The latter, as discussed elsewhere was basically a badgered 972.

The 956 was not introduced until 1914 (s/n 1130501) and was essentially a rebadged 974.

The 952, 950 and 954 introduced a new escapement design that eliminated the poised pallet lever assembly, the Emery oil retention grooves on the escape wheel and the radiused pallet jewels. This is the Hamilton escapement so familiar to watchmakers today.

The period between 1912 and 1915 appears to be the fourth and Hamilton's last period of experimentation of the watch market. The 978 (a 3 position adjusted 974) was introduced in 1912 (s/n 891601) to serve the developing interurban RR market. This was followed in 1913 by the 994 (S/n 1153301) a 21 J bridge model. This completed the series or RRG bridge models offered at the time (23J 950, 19J 952 and 17J 954).

During this pre WWI period, Hamilton had the unadjusted 974 competing with the 3 position 978. In 1914 Hamilton introduced the 956 as a cased version of the 974.

These observations reveal that during the first 15 to 20 years of 16 size production, Hamilton kept a keen eye on marketing and innovation. They ensured that cost of production across the models was low and that the added cost of higher grade movements was not significant. The materials used in the watch production were insignificant compared to the cost 3 of months in the Timing Department.

When Hamilton introduced new grades, it seems that tracked sales closely to determine which grades to drop and which grades to produce. There is a point where more profit is made form a higher sales rate of lower priced watches (992) compared to fewer sales of higher priced movements (990).

Below is a table of Hamilton Grades in the order in which they were put into production by assigned serial number. All watches before 1903 used positive pendant setting. After that, it can be mixed

until around 1907 when the negative pendant set became popular. All 5 position adjusted watches made before 1908 (including pendant set hunting cased movements) qualified for Rail Road Service.

SR= Single Roller Escapement (as introduced)
DR= Double Roller Escapement (as introduced)
MB= Motor Barrel

Grade	Serial Number	First Year out of Finishing Dept
962 (17J Bridge, 5 Pos, DR)	50001	1896
964 (17J Bridge, SR)	50011	1895
960(21J Bridge, 5 Pos, DR)	50061	1896
963 (17J Bridge, 5 Pos, DR)	51001	1896
965 (17J Bridge, SR)	51011	1896
961 (21J Bridge, 5 Pos, DR)	51061	1895
968 (17J ¾ plate, SR)	52001	1896
972 (17J ¾ plate, 5 Pos SR)	52011	1896
974 (17J ¾ plate, SR	52251	1897
976 (16J ¾ plate, SR	52301	1896
966 (17J ¾ plate, DR)	52491	1896
969 (17J ¾ plate, SR)	53001	1896
973 (17J, ¾ plate, 5 Pos SR)	53021	1896
977 (16J ¾ plate, SR	53071	1897
975 (17J ¾ plate, SR	53501	1897
967 (17J ¾ plate, DR)	53901	1897
970 (21J ¾ plate, 5 Pos DR)	70201	1901
971 (21J ¾ plate, 5 Pos DR)	71201	1901
990 (21J ¾ plate, 5 Pos DR)	302001	1903
992 (21J ¾ plate, 5 Pos SR)	302101	1903
993 (21J ¾ plate, 5 Pos SR/DR)	347101	1905
991 (21J ¾ plate, 5 Pos DR)	347181	1905
952 (19J ¾ plate, 5 Pos MB DR)	750701	1909
950 (23J, Bridge, 5 Pos MB DR)	775501	1909
954 (17J ¾ plate, 5 Pos DR)	797201	1910
978 (17J ¾ plate, 3 Pos SR)	891601	1912
956 (17J ¾ plate SR)	1130501	1914
994 (21J, Bridge DR)	1153301	1913
996 (19J, Motor Barrel DR)	1156001	1915