ELINVAR

IN YOUR WATCH

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Automatic Safety Control
For Railroad Timepieces

HAMILTON WATCH CO.
Lancaster, Pa.

Dr. Ch. Ed. Guillaume, who discovered and developed Elinvar. For this outstanding achievement, he was honored with the Nobel Award in Physics. Dr. Guillaume is head of the International Bureau of Weights and Measures, Commander of the French Legion of Honor and member of the French Academy. His scientific accomplishments have won for him an international reputation.

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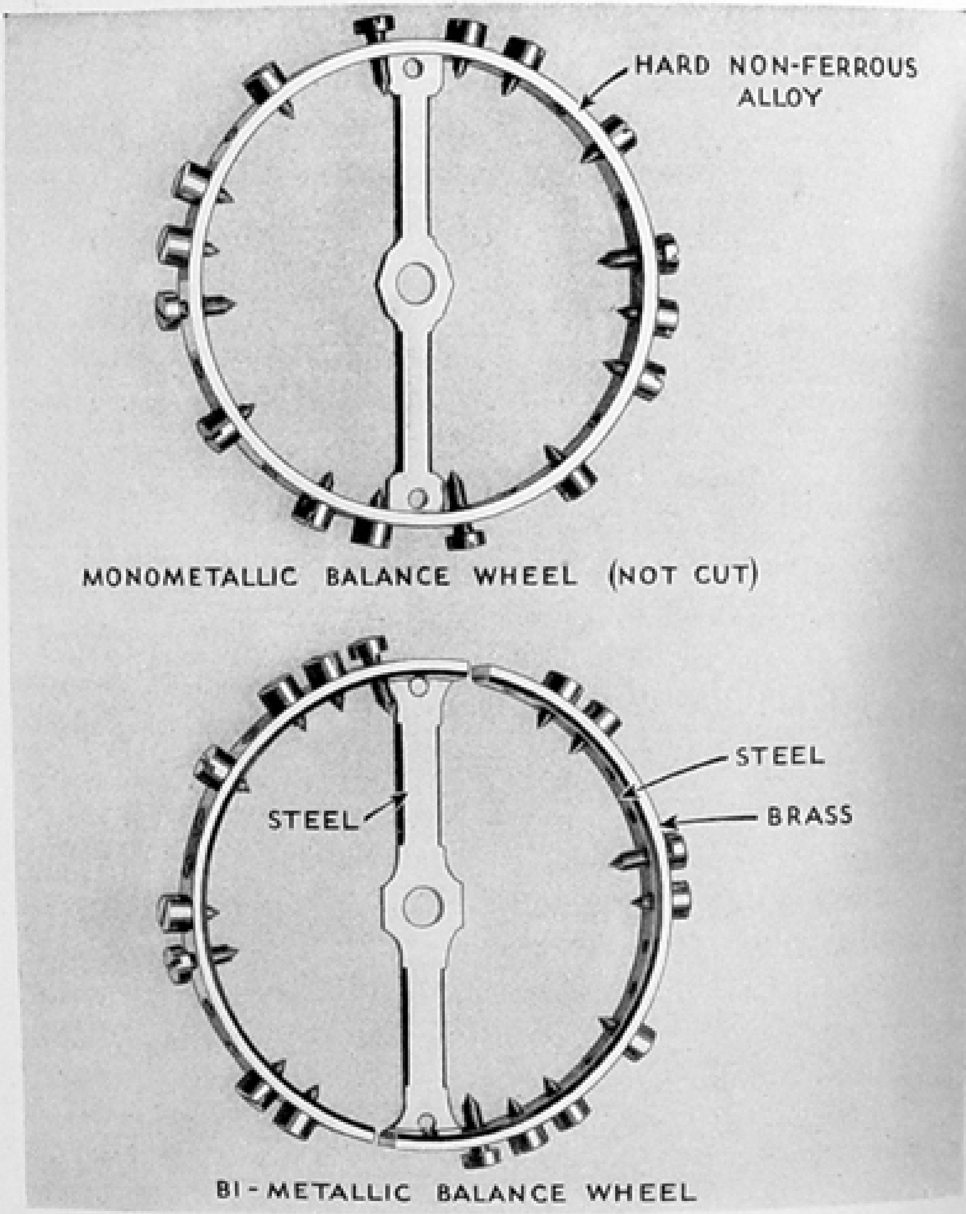
ACCURATE time — all the time and under all conditions! It is one of the most vital needs of railroad men. Yet railroad watches are subjected to a great variety of unfavorable conditions — temperature changes, humidity and magnetic fields, to mention just three. For years even the finest watches made in America have had to combat these hazards.

Now comes a dramatic discovery that represents a basic improvement in the construction of high-grade watches. It is Elinvar, a new metallic alloy, that makes possible a watch giving accurate time in spite of temperature changes — a watch proof against rust spots on hairspring or balance wheel — a watch relatively unaffected by magnetism.

Here at last is a watch that the railroad man can depend upon for accurate time under the most adverse conditions. Elinvar brings to the



Photographs of monometallic balance wheel (at top) and bimetallic balance wheel (bottom).

railroad man a new factor of safety that can be compared with the benefits of automatic train control.

After five years of painstaking experimental work, the Hamilton Watch Company is introducing the 992 Elinvar watch movement, a monumental forward step in the construction of watches. The 992 Elinvar watch movement differs from the famous 992 in that the bimetallic balance wheel and conventional steel hairspring have been replaced by a monometallic balance wheel and an ELINVAR hairspring. This vital improvement offers to railroad men the outstanding benefits of Elinvar in a railroad watch of time-tested reputation.

HOW TEMPERATURE AFFECTS A WATCH

The elasticity (springiness) of the conventional steel hairspring decreases as the temperature rises. In other words, it becomes weaker when warmed and stronger when cooled. Without any correction for this effect a watch will run slow when warm and fast when cool. Also when the balance wheel is heated the mass is carried farther from the center of oscillation and the watch will lose. The effect of temperature change on the balance is much less than the change due to elasticity of the hairspring; but both are present and have the same effect on the watch, that is, they cause the watch to run slow when warmed and run fast when cooled.

In the conventional high-grade watch this error caused by temperature change is overcome by using a bimetallic balance so designed that a portion of its weight is moved toward the center of oscillation on heating and away from the center of oscillation on cooling. This action is sufficient to overcome the errors in timekeeping caused by the change in elasticity of the hairspring and expansion of the balance due to heat.

THIS WAS THE PROBLEM

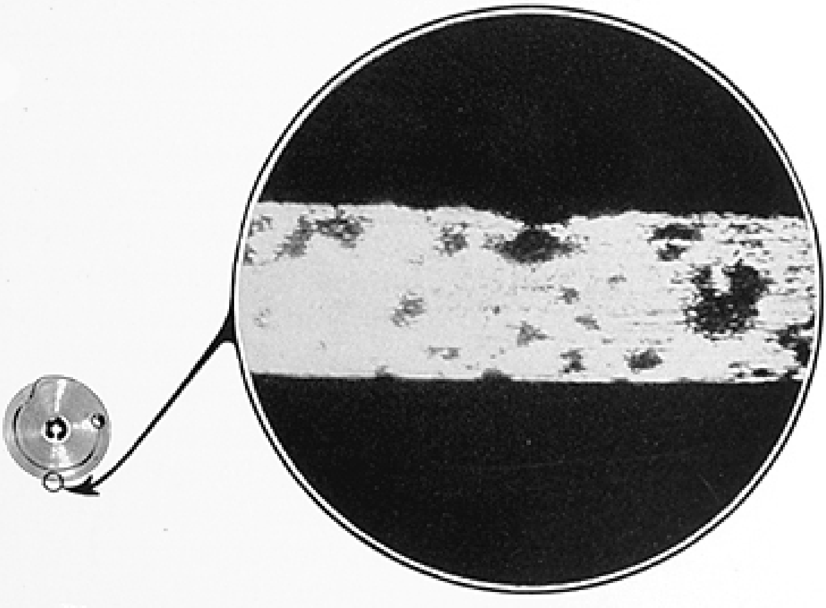
If it were possible to obtain a metal from which hairsprings could be made, the elasticity of which was constant in spite of temperature changes, and a metal from which the balance wheel and balance screws could be made, which would likewise not expand or contract with change in temperature, it would be possible to construct a watch unaffected by temperature changes. Such a watch would have no need for a bimetallic balance wheel with its attendant troubles.

Better still, if it were possible to obtain a metal for hairsprings in which the elasticity was affected by temperature in the reverse manner to that of ordinary hairspring, then it would be possible to use the conventional metals for the balance wheel and screws. And by properly designing the combination of hairspring and balance the effect on the timekeeping of a watch, due to expansion of the balance wheel with increase in temperature, would be counteracted by the hairspring becoming stronger. Automatic temperature compensation of the watch movement would thus be obtained. Now at last, a metal for hairsprings has been developed in which this age-long dream of an automatically temperature-compensated watch has finally been realized. It is known as ELINVAR.

THE DEVELOPMENT OF ELINVAR

After many years of experimental work Dr. Ch. Ed. Guillaume, Director of International Bureau of Weights and Measures at Paris, was able to discover and then develop with the aid of his colleagues an improved alloy steel in which the elasticity remains constant with temperature change, or in which the elasticity can be made to change opposite from that of other known metals. In Elinvar an alloy steel has been obtained, which, when used with a balance wheel having a correct temperature coefficient of expansion, will give the same or better temperature compensation than is now obtained in watch movements by use of a bimetallic balance wheel. Other nickel-steel alloys than Elinvar have been used for hairsprings in experiments but they usually do not remain stable, that is, they change their elasticity with age. Elinvar has eliminated this fault as its elasticity does not deteriorate nor change over years of constant use.

Elinvar should not be confused with INVAR, which is another nickel steel alloy discovered by Dr. Ch. Ed. Guillaume. Invar does not change its length, whereas Elinvar does not change its elasticity when subjected to temperature changes. For his great achievement in developing Elinvar, Dr. Guillaume was awarded the Nobel Prize, one of the highest honors that can come to a man of science.



Photomicrograph of rust spot on steel hairspring enlarged 75 diameters.

THE HAZARD OF RUSTY HAIRSPRINGS

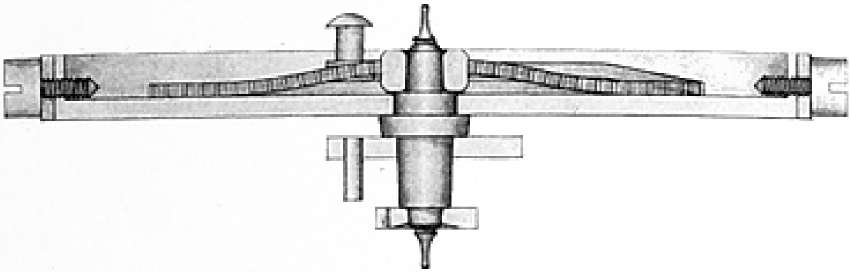
Rust is a film of oxide formed on any metal by corrosion. Its formation on moving steel parts of watches has always been a source of trouble, especially on steel hairsprings. Watch repair shops estimate that 30% of all watches brought in for repairs have rusty hairsprings. A tiny spot of rust on any part of a steel hairspring will be the start of trouble. As corrosion slowly spreads and eats into the pores of the steel the spring becomes weaker and weaker causing the watch to continually run slower and slower. Moving the regulator will temporarily correct the time but does not overcome the trouble because the rust spot continues to spread like a contagious disease.

Owners of the 992 Elinvar watches will no longer have to fear the troubles encountered by rusty hairsprings because the hairsprings are made of ELINVAR, a rustless nickel-steel alloy.

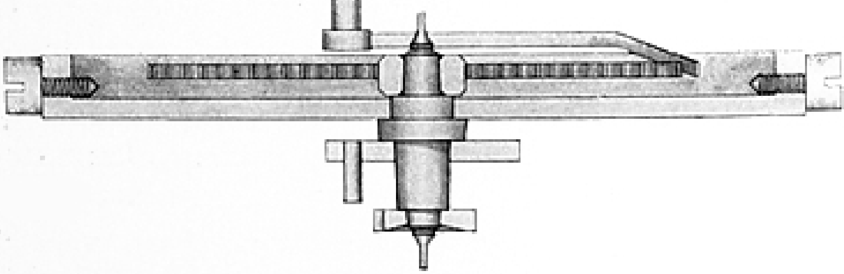
ANOTHER ENEMY — MAGNETISM

Magnetism is an enemy with which watch owners must contend. A magnetized watch will not keep time accurately.

When a conventional watch movement is magnetized the steel hairspring and steel balance arm become permanently magnetized. This



Cross section of balance with ordinary steel hairspring and bimetallic balance wheel, showing effect of magnetization.



Cross section of balance with Elinvar hairspring and monometallic balance wheel.

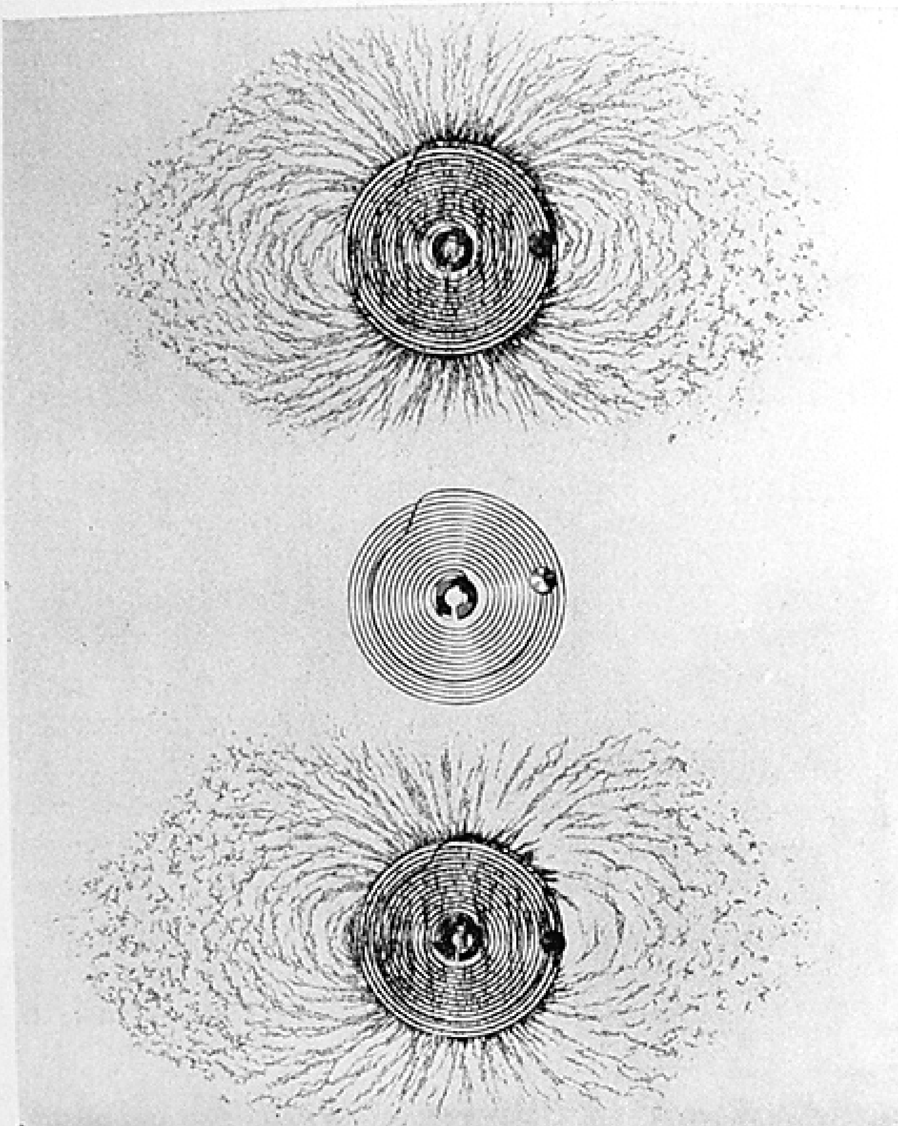
causes the hairspring to be attracted to the balance arm, which, in turn, may cause the watch to stop or if not so strongly magnetized, the hairspring may touch the balance arm occasionally when the watch is held in certain positions and thus cause very erratic timing.

The 992 Elinvar watch is constructed with materials and parts designed to help the watchmaker and watch owner combat the destructive effects of a magnetized watch. No longer will the owner of a 992 Elinvar watch have to be careful about wearing his watch too close to radio sets or telephones nor be careful about walking too close to unshielded dynamos.

THE ADVANTAGES OF ELINVAR

In the 992 Elinvar watch with a monometallic balance and Elinvar hairspring, this destroying effect does not exist. The balance and balance arm are not magnetic and thus will not attract the hairspring. The hairspring is made of Elinvar and, although an alloy of steel, cannot be permanently magnetized. Thus, the attraction between the balance arm and hairspring is entirely eliminated. The 992 Elinvar watch may, however, stop while in a strong magnetic field, but when removed from the field will continue to run and keep time as well as before with proper regulation, in spite of the fact that due to the effect of the magnetic field all of the steel parts in the watch movement, except the Elinvar hairspring, may have become permanently magnetized.

In the illustration on page 12 the two hairsprings at the top and bottom are the conventional steel hairsprings and the one in the center is an ELINVAR hairspring. All three have been passed through the same magnetic field. Steel filings have been dusted over them. The steel hairsprings have become permanently mag-

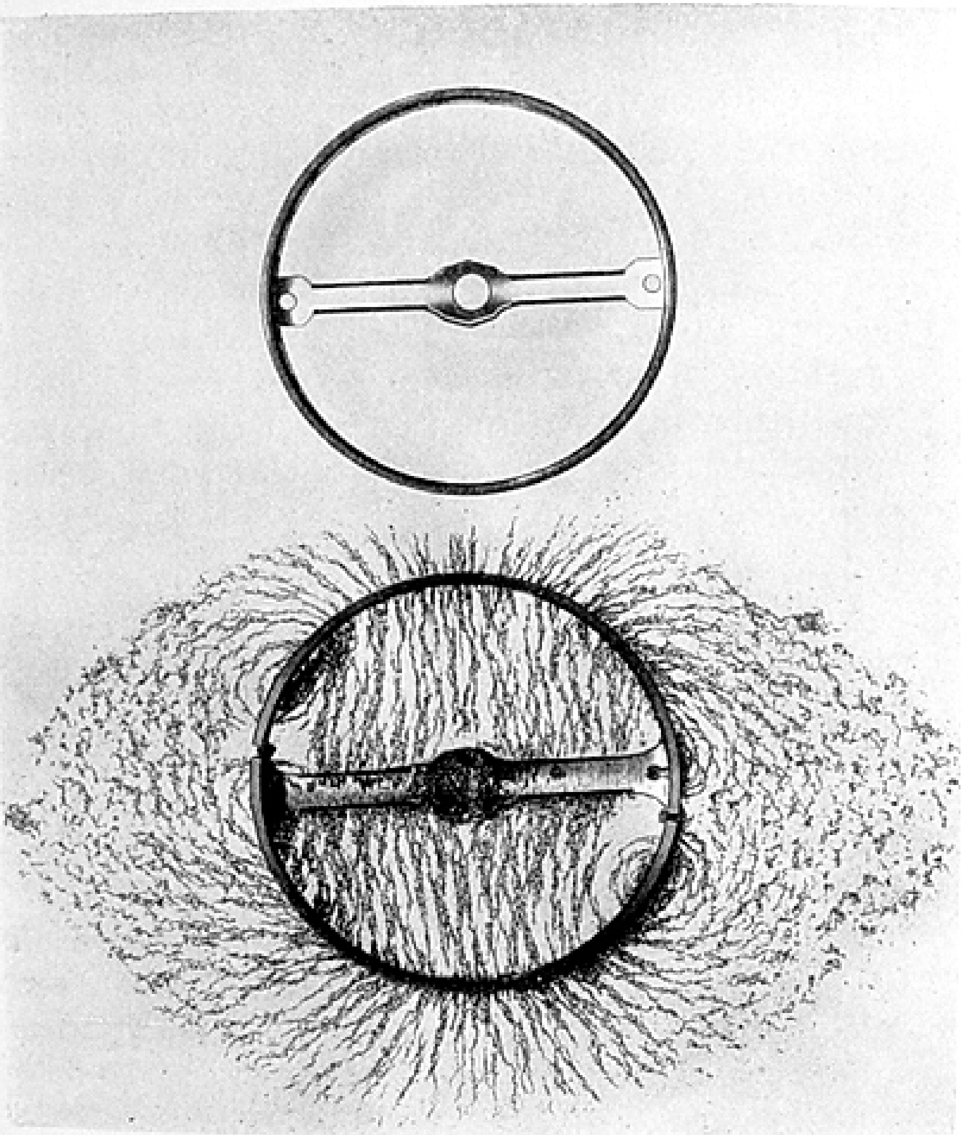


Photograph of conventional steel hairspring (top and bottom) showing attraction for steel filings; Elinvar hairspring at center. All three hairsprings have been subjected to the same magnetic field.

netized and attracted the steel filings as shown. The Elinvar hairspring has not become magnetized and therefore does not attract any of the particles of steel. The same is true with the balance. The balance on top (see page 14) is a monometallic cut balance made of a non-ferrous metal, and the one below is a conventional bimetallic steel and brass balance. Both have been passed through the same magnetic field and submitted to the same test as explained above.

THE 992 ELINVAR AS A TIMEKEEPER

The requirements of railroads where time inspection is maintained demand that a watch run within thirty seconds variation per week, during which time the watch might be in almost any position. To be sure that all 992 Elinvar watches will keep time within railroad requirements, they must be adjusted and tested to operate in any of five different positions; dial up, dial down, twelve up, nine up and three up. Most of the adjustments and corrections are made on the balance, or balance staff pivots. A slight jarring or bumping may cause watches with the ordinary bimetallic balances to change the rate of time. This is attributed largely to the fact that the loose ends of a bimetallic balance will spring either closer or away from center of oscillation causing the balance to get out of poise and con-

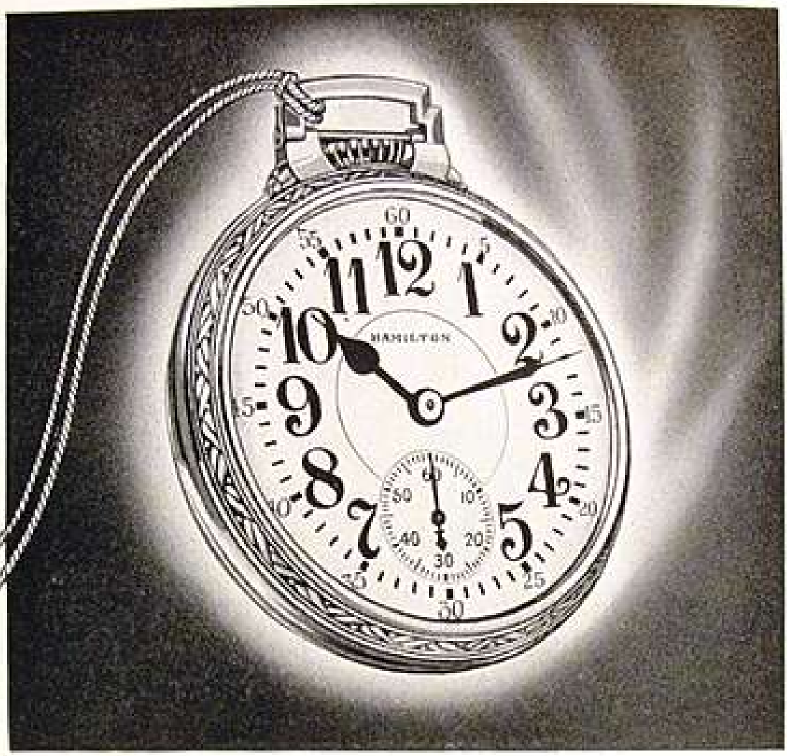


Monometallic balance wheel (top), and bimetallic balance wheel (bottom) showing attractions for steel filings after both have been subjected to the same magnetic field.

sequently cause erratic timing. This possibility has been a source of trouble ever since the use of a cut bimetallic balance in watches but a bimetallic balance was necessary to compensate for errors caused by temperature changes. Or, in other words, an error was used to compensate and correct another error.

The 922 Elinvar watch is constructed to eliminate the original error in time due to change of elasticity in different temperatures, therefore, there is no need for the cut bimetallic balance. This naturally means that the 922 Elinvar watches will make it possible to maintain, while being carried, the original adjustments that were given to the watches before leaving the factory.

This is the story behind Elinvar. The great advantages that flow from this discovery are now available to you in the 992 Elinvar watch. If minutes mean money to you, it will pay you to own a Hamilton 992 Elinvar watch. You will enjoy accurate timekeeping under the most adverse conditions and you will eliminate rust on the hairspring, the commonest cause of watch repair bills. The first step is to ask your jeweler or time inspector to show you the new Hamilton 992 Elinvar Watch.



Railroad Model No. 8
992 Elinvar

This new model is fitted with the new 992-Elinvar movement. Available in 14-K filled white gold and in 10-K filled natural yellow gold. The 992-Elinvar Railroad Watch will be supplied in a variety of other case styles. Look for the Elinvar tag.

The Hamilton Watch Company is Exclusive Licensee for Elinvar Hairsprings under U.S. Patents No. 1,313,291, dated August 19, 1919 and No. 1,454,473, dated May 8,1923.