Main Springs

Waltham Watch Co.

Waltham, Mass.

MAINSPRINGS

"Spring flies and carries with it all its train."

—*Schiller*

WALTHAM
WATCH COMPANY

WALTHAM, MASSACHUSETTS, U. S. A.

LABORATORY WHERE SAMPLES FROM INGOTS ARE ANALYZED

ALL matter has physical properties or characteristics, which may be either simple or complex. A knowledge of the properties of the various forms of matter is not only interesting, but, in general, is very useful to mankind, especially to the mechanic or the manufacturer who is engaged in the making of articles from metal.

So thoroughly is such definite knowledge appreciated by the most progressive manufacturers of today, that the services of the analytical chemist have become indispensable, and the up-to-date manufacturer, by the aid of his chemist, is able to secure a product of practically absolute uniformity.

It is probably true that in recent years no line of manufacture has shown greater progress than in the making of special steels for special purposes, until at the present time the variety of special grades of steel is only limited by the uses for which it is desired.

Certain properties are common to all grades of steel, such as weight, ductility, hardness, etc., but as they are by no means uniform in degree, steel for certain uses would need to possess some one property in a special ratio.

FRACTURE SHOWING CONTRAST BETWEEN POOR QUALITY OF STEEL AND FINE STEEL SUITABLE FOR MAINSPRINGS

It is evident that the particular steel which would be suitable for making mainsprings should possess a number of properties. First, it should be homogeneous ; second, it should possess the constituents which will permit of hardening; third, it should be capable of receiving a degree of temper suitable for the severe and exacting service to which it will be subjected. It should also be capable of receiving a good finish, and a clear and distinct color. It is the work of the steel manufacturer to so combine the various ingredients composing the steel as to secure the above qualities, as it is also the task of the mainspring manufacturer to so treat and manipulate the steel as to produce good, lively and durable watch springs.

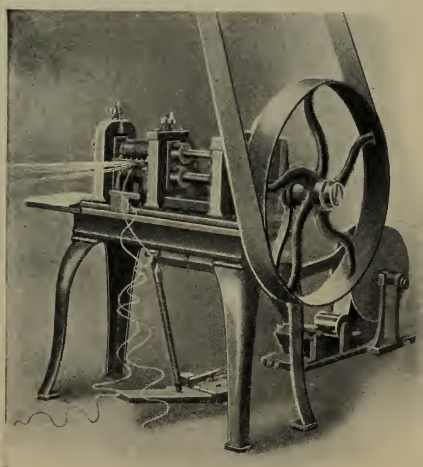
STEEL WAREHOUSE SHOWING ASSORTMENTS OF INGOTS

It is safe to assert that very few watch manufacturers, either in America or in Europe, even attempt the making of their required mainsprings; but the American Waltham Watch Company, who for many years purchased their springs in Europe, having found it difficult to secure mainsprings of satisfactory quality, were compelled to manufacture their own springs, as their requirements embraced a large variety and quantity, as well as high quality. Beginning in a small way, but by radically new methods superior to the traditional ways of manufacturing in Europe, springs as first produced at the Waltham factory were far superior in quality and finish to the imported article, and as careful experiments have demonstrated the greater value of later means and appliances, it can, at the present time, be rightly claimed that the Waltham Company lead the world in the production of watch mainsprings, not only in quantity, but in uniform excellence of quality.

The twenty years of experience in making mainsprings have been years of progress in which much has been learned, and we may rightly claim an extensive knowledge of their nature and behavior; yet we are free to admit that there are some phenomena concerning them which yet remain to be explained, and while we would not evade the responsibility for any failure in manufacturing mainsprings, we would endeavor to convince the thoughtful mind that not all the secrets of nature have yet been fathomed.

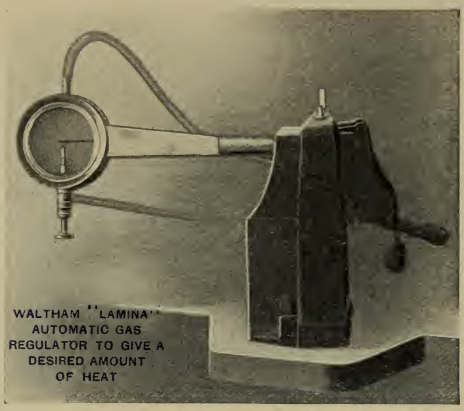
ONE DAY'S PRODUCT
WALTHAM FACTORY
15,000 SPRINGS

The prime requisite for a mainspring is elasticity or resilience, and that quality is obtained by means of a suitable "temper." The Standard Dictionary defines this process briefly, but rather imperfectly, as follows: "Temper: to bring (a metal) to a certain degree of hardness by heating and suddenly cooling." "In tempering steel the metal is usually heated until it assumes a color, as yellow, brown, purple or blue, and then plunged into water," etc., etc. The foregoing definition, while sufficing for the general reader, is quite superficial, and not intended to be scientific. Our best scientists are now less positive in their assertions than formerly, but their investigations in the chemistry of steel seem to reveal certain laws governing its action under given conditions. The theory relating to the tempering of steel is that when the steel is subjected to a sufficient degree of heat (commonly a "cherry red"), the molecules of metal are free from any special cohesive strain. If after being so heated the metal is allowed to cool very slowly the molecules will still be measurably free, and the steel will be relatively soft, or "annealed," so that it can be cut with suitable tools, such as files, chisels and cutters. If, however, the steel, after being brought to the red heat, be suddenly plunged into water or other liquid, there will result a condition of stress in the molecules, and, if the article is so small that the chill affects the entire mass, there will be an accompanying shrinkage in dimension, as if the molecules were shrinking as close to each other as possible. In this condition the steel is *hard* and *brittle*. In certain



MACHINE CUTTING, IN 30 MINUTES, 7 MILES OF STEEL, PROPER WIDTH FOR MAINSPRINGS

kinds or grades of steel there is a liability of the sudden cooling producing a violent rupture in the mass. The condition of stress occasioned by the sudden cooling of the steel can be modified or relieved at will by an after application of heat, the degree of which will determine the resulting "temper," which can be varied to meet the requirements for which the steel is desired. To secure the resilient quality which is the essential of a watch mainspring, and which should be entirely uniform, it is requisite that both the hardening and the tempering processes should be conducted with the greatest possible precision, so that just the right amount of heat, and no more, will be imparted to the steel for the hardening process, and a still nicer adjustment of heat for producing the desired "spring temper." If the steel be overheated in hardening, its quality will be ruined, and it never could make a reliable spring; if it be overheated in tempering, its elasticity will be lost; while if not sufficiently heated, or "drawn," it will be too brittle for safety. The employment of gas as a fuel makes possible a nicety of adjustment of heat exactly adapted to obtain the desired results.



WALTHAM "LAMINA" AUTOMATIC GAS REGULATOR TO GIVE A DESIRED AMOUNT OF HEAT

The efficacy of a spring consists in its ability to resume the form from which, by some force outside itself, it has been diverted; so that, if a watch mainspring be tempered when in practically the form of a straight ribbon or strip, and then coiled within the mainspring barrel, its effective use consists in its endeavor to resume its normal form of straightness, which effort is utilized by compelling it to turn the entire train of watch wheels, and that only at the speed governed by the movement of the "balance" wheel. If, however, the spring be in a curved form when receiving its temper, instead of being straight, and be coiled into the barrel in a reversed condition of curve, it is evident that it will possess an additional ability to pull, so that a spring so tempered and coiled will possess the effective force of one of greater thickness tempered in the straight condition. This is particularly true of the Eclipse and Pioneer resilient springs which are made by patented processes evolved by the American Waltham Watch Company

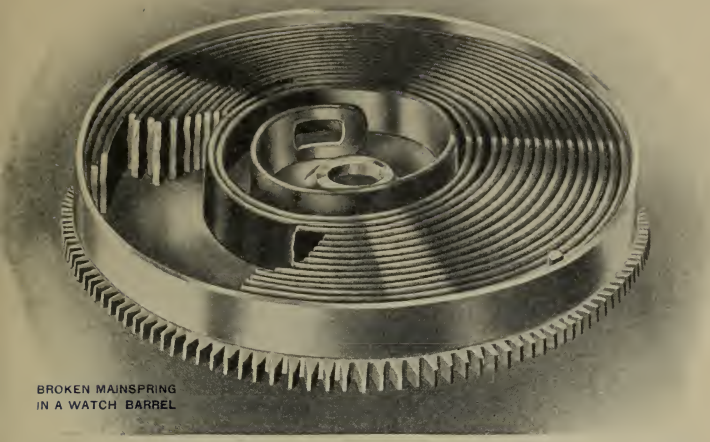
A DOZEN RESILIENT SPRINGS

for hardening, tempering and finishing, bringing out all the possibilities contained in a carefully-selected strip of steel, producing what we believe to be the most reliable and highly-finished mainspring made in the world.

After having secured the exact temper desired, so that the spring is not so soft as to set nor so hard as to break, there remains a liability of curious and unexplained failure, which may or may not manifest itself at once. It is noticeable that during the summer months the number of broken mainsprings in watches far exceeds the breakage occurring at other seasons. It has been supposed that such breakage may have been caused by electrical disturbances in the atmosphere or excessive humidity. As an indication that there may be ground for such a theory, it may be related that workmen in large repair shops or factories, employed evenings when the shops were still, have been startled by the almost simultaneous breaking of numbers of mainsprings in watches which were lying on the work benches or hanging in cases. Such a phenomenon is often followed in a short time by a thunder storm.

FRANKLIN AND HIS KITE

It cannot be claimed, therefore, that mainsprings will never break. It is the manufacturer's endeavor, however, to make them as near unbreakable as is possible without sacrificing their proper elasticity. Watch wearers as well as watch dealers and repairers, should concede that it is far better that a mainspring

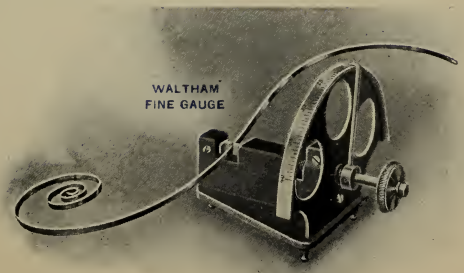


BROKEN MAINSPRING
IN A WATCH BARREL

be so tempered as to possess a good amount of life or "pull," even if there be a somewhat increased liability of occasional breakage, than an absolute security against breakage with the consequent absence of vigor in the spring, which would result in a sluggish, and therefore unreliable, action of the watch movement into which such a spring was put.

In the manufacture of mainsprings it is of the utmost importance that the springs be made absolutely accurate to stated widths and thicknesses. The Waltham Watch Company have spared no expense to make possible the manufacture of this product exact to standards.

For the final measuring of the finished spring, a special gauge with metric graduations is used, which will quickly show, by the use of a large index, a variation of .0005 centimeters. As there



WALTHAM
FINE GAUGE

are 2.54 centimeters in one inch, the absolute degree of accuracy insisted upon in the Waltham factory is apparent.

Many watchmakers use, for gauging springs, a split gauge into which the spring is placed and the thickness or width is supposed to be indicated by a number on the margin. As no two people would exert the same amount of pressure in placing the spring in the gauge, and as constant use would wear away the metal, it is apparent that such a gauge is unreliable when used as a standard for accurate measuring.

Lists have been furnished giving the sizes of Waltham springs corresponding to the numbers marked on these split gauges, but it is obvious that such lists could not be entirely reliable owing to the variations which are bound to be found when such gauges are used. We strongly advocate all watchmakers using for measuring mainsprings, some reliable gauge that is marked with *metric* graduations, giving in metric terms the exact width and thickness of the mainspring. Metric micrometers, made by standard tool manufacturers, are good for this purpose if they are provided with the ratchet stop which limits the amount of force which can be applied. Such tools are, however, rather expensive.

To meet the need of a comprehensive mainspring gauge which would be accurate and convenient and yet sold at a price within the means of the ordinary watch repairer, the Waltham Watch Company has provided and offers for sale the Waltham Mainspring Gauge (see cut on the last page of the book). As the graduations on the gauge represent metric terms, the watch repairer can order the springs by the numbers indicated on the gauge, both width and thickness, and feel sure of getting just the spring he wants.

Table Showing Thickness or Strength of Mainsprings

Dennison Numbers	Waltham Thickness in Centimeters	Dennison Numbers	Waltham Thickness in Centimeters
0000	.029	5	.018
000	.027	6	.017
00	.026	6½	.016
0	.025	7	.015
0½	.024	8	.014
1	.023	9	.013
2	.022	9½	.012
3	.021	10	.011
3½	.020	11	.010
4	.019	12	.009

Table Showing Width of Mainsprings

Dennison Numbers	Waltham Widths in Centimeters	Dennison Numbers	Waltham Widths in Centimeters
1	.100	23	.320
2	.110	24	.330
3	.120	25	.340
4	.130	26	.350
5	.140	27	.360
6	.150	28	.370
7	.160	29	.380
8	.170	30	.390
9	.180	31	.400
10	.190	32	.410
11	.200	33	.420
12	.210	34	.430
13	.220	35	.440
14	.230	36	.450
15	.240	37	.460
16	.250	38	.470
17	.260	39	.480
18	.270	40	.490
19	.280	41	.500
20	.290	42	.510
21	.300	43	.520
22	.310		

On opposite page is a list of Waltham Mainsprings by catalogue numbers, and the minimum and maximum width and thickness of each spring which have been decided upon by the Waltham Watch Company as best adapted for each; also a revised list giving the comparative Dennison numbers in width and thickness to Waltham sizes. The strength of a Waltham spring, determined by the thickness, is denoted in this schedule in thousandths of a centimeter. To illustrate: If a Waltham Resilient Spring No. 2205 is wanted, weak, medium or strong, it should be ordered .021 cm. for weak; .022 cm. for medium; or .022½ cm. for strong. The Waltham standard length of springs is given in both centimeters and inches.

All Waltham Resilient Mainsprings, either Pioneer (blue) or Eclipse (silver), are stamped or etched A. W. W. CO., as shown by the illustration below. This enables watchmakers to identify Waltham Resilient Mainsprings.

LIST OF WALTHAM MAINSPRINGS

Catalogue Number	Size	Model	Barrel Depth	Width of Spring in Centimeters	Thickness of Spring in Centimeters	Length in Centimeters	Length in Inches
2200-A	20	1st Ser. 1862	.270	.255 to .260	.020 to .021	58.42	23
2200-B	20	2d Ser. 1862	.315	.295 to .300	.020 to .021	60.96	24
2200	18	1859	.310	.285 to .290	.020 to .021	58.42	23
2201	18	Old Style '57	.310	.285 to .290	.021 to .022	58.42	23
2202	18	New Style '57	.310	.285 to .290	.021 to .022	58.42	23
2203	18	1877	.320	.290 to .295	.021 to .022-.022½	53.34	21
2204	18	1879	.270	.250 to .255	.021 to .022-.023	53.34	21
2205	18	1883	.320	.295 to .300	.021 to .022-.022½	53.34	21
2206	18	K. W. 1870	.255	.230 to .235	.021 to .022	53.34	21
2207	18	S. W. 1870	.275	.250 to .255	.021 to .022-.023	53.34	21
2208-A	16	1860	.248	.230 to .235	.020 to .021	53.34	21
2208-B	16	1862	.248	.230 to .235	.021 to .022	53.34	21
2208-C	16	1868	.248	.230 to .235	.020 to .021	53.34	21
2208	16	1872	.248	.230 to .235	.021 to .022	53.34	21
2209	14	1870	.240	.225 to .230	.020 to .021	53.34	21
2210	14	1874	.225	.205 to .210	.021 to .022-.022½	48.26	19
2211	14	1884	.270	.250 to .255	.021 to .022	48.26	19
2212	10	1st Ser. 1861	.225	.205 to .210	.019 to .020	48.26	19
2213	10	2d Ser. 1861	.250	.230 to .235	.019 to .020	48.26	19
2214	10	1874	.250	.230 to .235	.020 to .021	48.26	19
2215	8 & 6	1873	.205	.190 to .195	.021 to .022	40.64	16
2216	1 & 0	1882 & 1887	.185	.170 to .175	.016 to .017-.018	40.64	16
2217	6	1889	.205	.190 to .195	.018 to .019-.020	40.64	16
2218	16	1888	.300	.280 to .285	.018 to .019-.020	63.50	25
2219	6	Regular	.220	.205 to .210	.012 to .015-.016	40.64	16
2220	0	Regular	.170	.150 to .155	.012 to .015-.016	40.64	16
2221	00	1891	.170	.150 to .155	.014 to .015	36.83	14½
2222	18	1892	.345	.325 to .330	.015 to .020	63.50	25
2223	14	1895	.300	.280 to .285	.018 to .019	57.15	22½
2224	12	1894	.230	.215 to .220	.012 to .015-.016	48.90	19¼
2224-A	12	1894	.230	.215 to .220	.012 to .015-.016	48.90	19¼
2225	14	1895	.300	.280 to .285	.018 to .019	57.15	22½
2226	J. S.	1898	.170	.150 to .155	.010 to .012-.013	34.29	13½
2227	16	1899	.300	.280 to .285	.015 to .019	63.50	25
2228	0	1900	.185	.170 to .175	.010 to .012-.013	38.10	15
2229	10L		.170	.150 to .155	.008 to .010-.011	26.04	10¼
2230	0	1907	.220	.205 to .210	.011 to .014	38.10	15

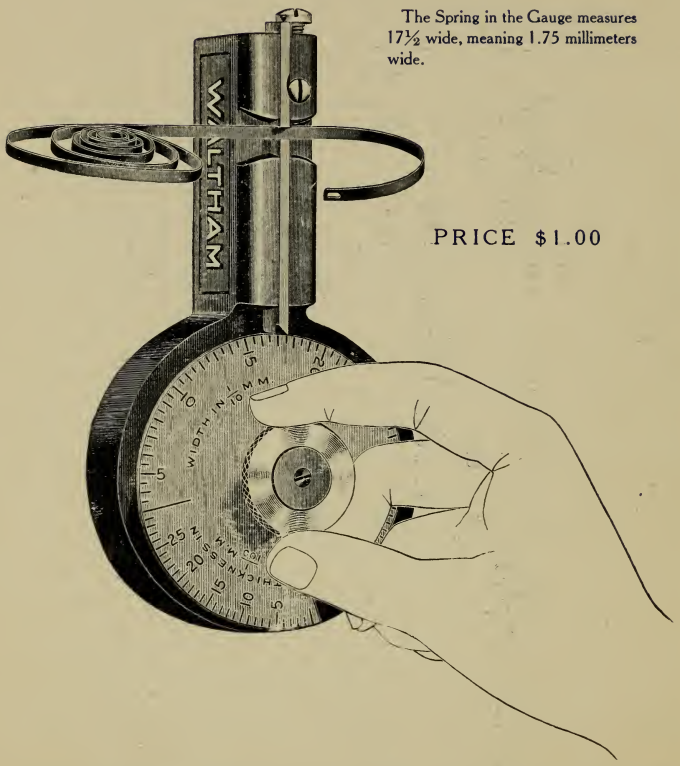
The WALTHAM MAINSPRING GAUGE

PATENTED JANUARY 1, 1907

A Gauge With Numbers That Stand For Something

The Spring in the Gauge measures 17½ wide, meaning 1.75 millimeters wide.

PRICE $1.00



Method of using the Waltham Gauge (with friction thumb piece) to determine accurately the **thickness** or **width** of a spring.