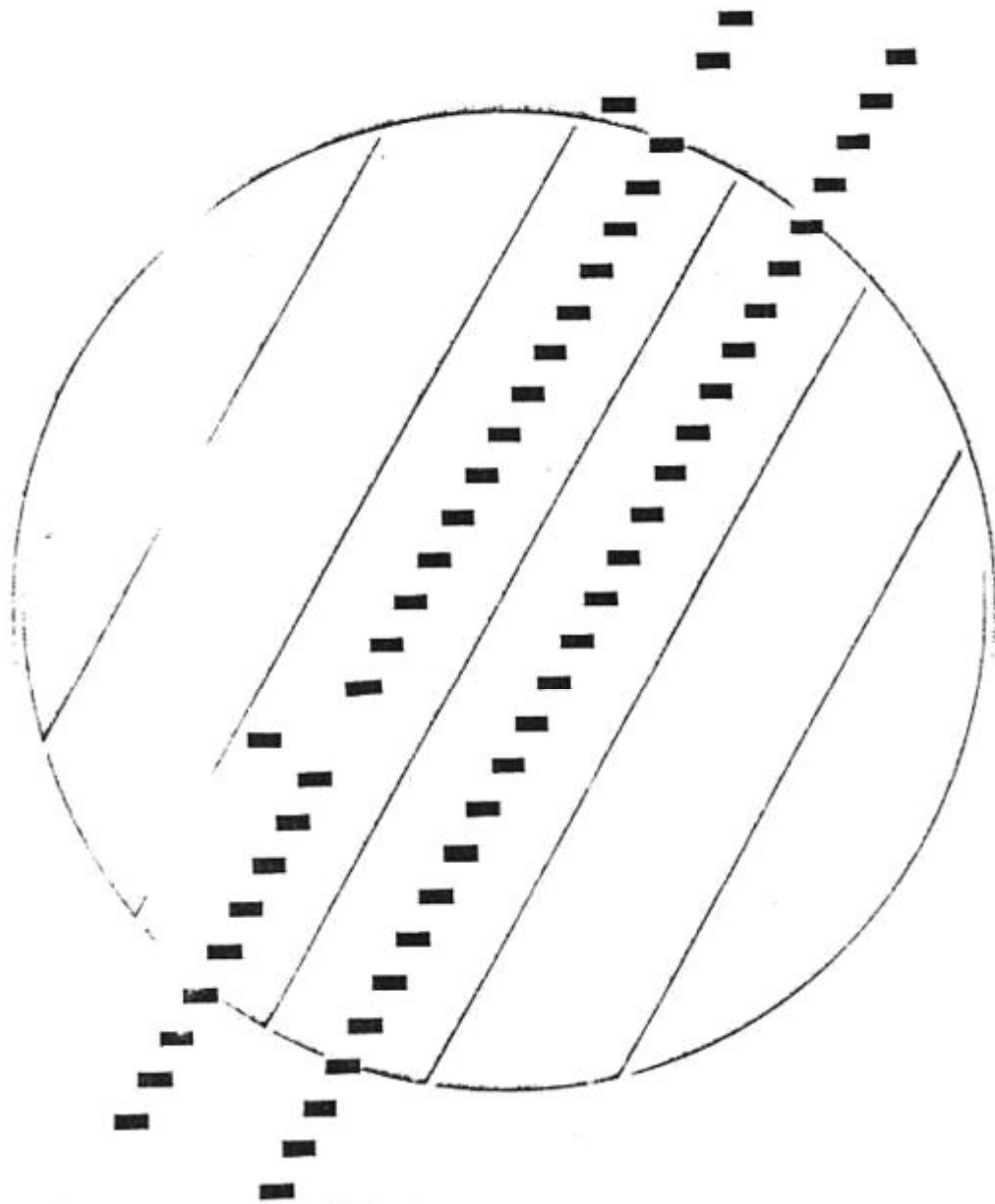


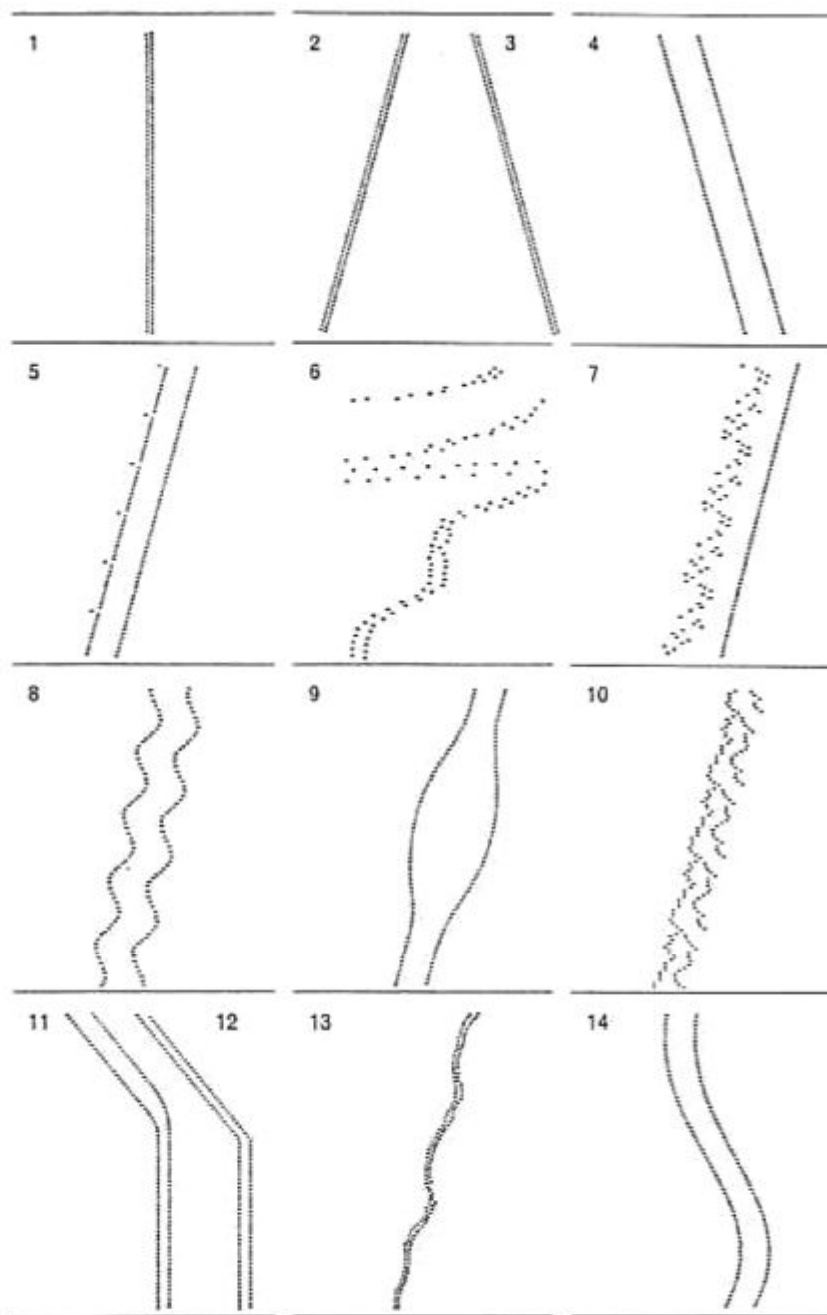
vibrograf[®]

Interpretation of Records



Contents	Definitions
2 Definitions	To avoid misunderstandings, the following definitions have been adopted:
4 Introduction Bibliography	Noise a combination or succession of sounds
5 Operating principle of the Vibrograf	Sound a clearly-defined part of a noise
6 Interpretation of 14 typical vibrograms (see picture opposite)	Daily lasting 24 hours
11 Uses of the Vibrograf Helpful reminders	Rate the degree of timekeeping ability at a given point of wind on the mainspring
	Daily Rate the amount of error indicated after being worn for 24 hours
	Vibration the distance travelled by the balance from one extremity of its swing to the other
	Oscillation the sum of two vibrations, i.e. the distance travelled by the balance from one extremity of its swing until its return to the same extremity
	Period the time taken by the balance to complete one oscillation
	Frequency number of oscillations per second
	Motion the angle of displacement of the balance measured from the position of rest to one of the extremities of its swing
	Isochronism the aptitude of an oscillating body to carry out oscillations of the same duration independently of their amplitude

Typical vibrograms



Introduction

The quality of a watch is determined by two main factors:

- 1 the accuracy of its rate in various positions and at different temperatures
- 2 its ability to maintain this accuracy over long periods.

A quality watch meets both of these essential requirements.

The ability of a watch to maintain its original accuracy depends on a combination of factors, the chief of which is the quality of its parts (balance and hairspring, time-train, mainspring, jewels, etc.) and lubrication conditions.

A thorough examination is therefore necessary to determine a watch's ability to maintain its accuracy.

On the other hand the accuracy of the rate can be tested very quickly and objectively with the aid of a watch rate recorder. Vibrograf is the best and most widely used machine of its kind. The record obtained, the "vibrogram", represents the instantaneous rate of the movement under examination, i.e. the rate measured at the point of wind of the watch and on the conditions of observation at the time of the test.

However the measurement of the instantaneous rate is not the Vibrograf's only duty. It can be used to detect in a few seconds (or at the most a few minutes) functional defects such as overmotion, a faulty escapement, variations in mainspring power transmission, and with an accuracy that in most cases makes it easy to locate the fault and carry out the repair.

The advantages offered by Vibrograf are such that watchmakers and manufacturers all over the world have

adopted it in preference to methods of direct observation.

To get the best service out of your Vibrograf, it is necessary to know how it works and, above all, how to interpret the vibrograms correctly.

This instruction brochure is designed to give the most important information in a practical form without requiring any specialized theoretical knowledge on the part of the watchmaker.

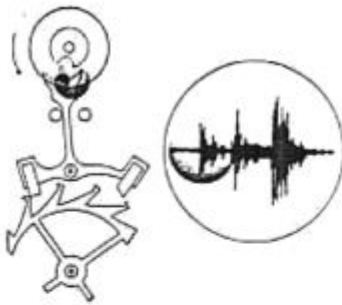
Instructions for starting the machine, its handling and maintenance, are given in our booklet "Operating instructions" supplied with every machine.

Bibliography

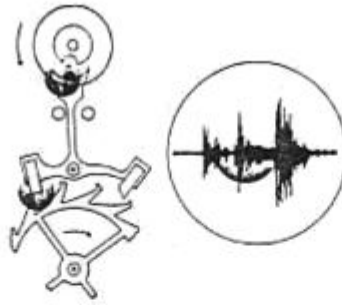
The following manuals are recommended to watchmakers requiring more detailed information:

"Joseph Bulova School of Watchmaking Training Manual", available through Authorized Bulova Material Distributors
"The Watch Repairer's Manual", by Henry B. Fried
"A Practical Course in Horology", by Harold C. Kelly
"Watch Adjustment", by H. Jendritzki
"Illustrated Professional Dictionary of Horology", by G.-A. Berner

To this may be added articles which have appeared in various American watchmaking journals, and those of L. Defossez in the "Swiss Horological Journal".



unlocking impact



impulse



drop

Operating principles of the Vibrograf

The principle on which the Vibrograf works is that of the "instantaneous" comparison of the rate of the movement being examined with a time standard of rigorous accuracy, the quartz oscillator.

The difference between the rate of the movement and the frequency of the quartz oscillator is charted in the form of a printed record: the vibrogram. This consists of a series of marks whose general slant indicates fast or slow, while the irregularities in the placement of the marks indicate a malfunction or maladjustment in the watch.

A reading device with a graduated scale measures the slope of the vibrogram and thereby indicates the instantaneous rate in minutes and seconds, easily and quickly.

The detection of defects is based on an analysis of the functions of balance and escapement.

An examination of a lever escapement reveals that three sounds take place in the course of one vibration:

the first sound occurs at the start of unlocking the pallet stone, when the roller jewel strikes the fork slot, giving a clear sound known as "unlocking impact";

a second sound is produced by the escape wheel on the impulse face of the pallet stone. This sound is known as "impulse". A secondary sound, produced by the reduction of the play at the roller jewel in the fork slot, occurs immediately thereafter, but is negligible;

a third sound occurs at the time of the drop of the escape wheel tooth against the locking face of the opposite pallet stone. Another sound is superimposed, caused by the lever striking the banking pins. The combination of these two sounds is called the "drop".

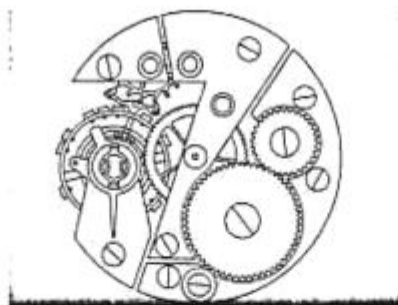
As a rule, the drop is the most intense of the sounds. This can be seen when the action of the escapement is viewed by an oscilloscope.

The marks printed on the paper must always correspond to the same sound made by the escapement, if a clear record is to be obtained.

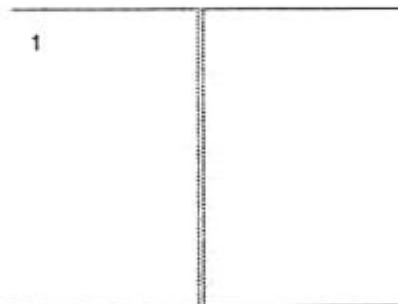
This need is met by adjustment of the volume control, which is able to record only one of the sounds of the escapement, normally the "unlocking". For this reason volume control is extremely important.

This adjustment is no problem with the Vibrograf: starting at minimum, it is only necessary to increase the volume control gradually until the vibrogram becomes clear (see page 11, §3)

Interpretation of 14 typical vibrograms
(see picture on page 3)



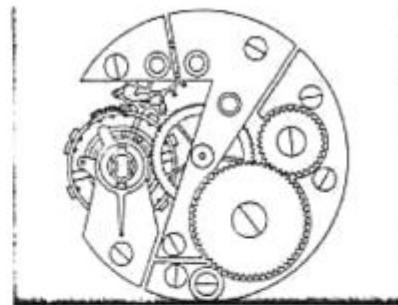
1



Running accurately

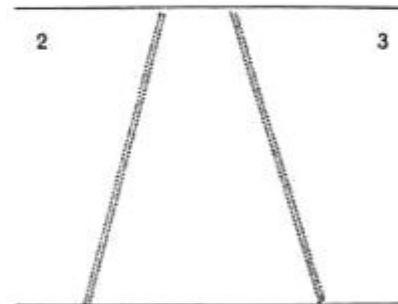
When the movement is running accurately, the vibrogram takes the form of a vertical record made up of either one or two straight lines parallel with the edge of the paper.

The position of the vibrogram with relation to the edges of the paper is of no importance.



2

3



Gain and loss

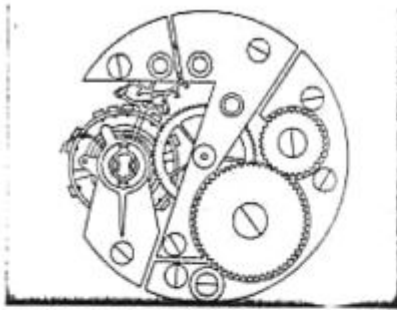
The slant of the vibrogram is the exact indication of the amount the watch is gaining or losing. This value can be read in seconds and minutes on the reading scale. Slanting to the right indicates a fast rate, slanting to the left indicates a slow rate.

Correction

The movement may be left on the Vibrograf watchholder.

In order to obtain the best possible daily rate under normal conditions of wear, the correction must allow for differences in rate at all positions. It is not always advisable to obtain a perfectly vertical line record.

For the same reason it is better to carry out the testing with the main-spring two-thirds wound (12 hours from fully wound).



4



Out-of-beat

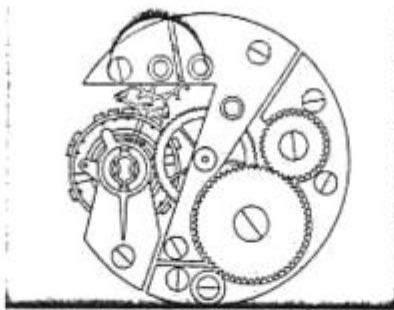
Out-of-beat is the result of an unequal duration of the two vibrations which make up the oscillation. The two lines appear on the vibrogram separated by a gap.

The importance of this defect can be estimated only by allowing for the motion of the balance. The lower the motion, the greater the gap for a given beat problem.

Correction

The escapement is put in beat by turning the collet on the balance staff, until the lines are sufficiently close together, preferably under 3 mm.

If the movement is equipped with a moveable studholder, the operation can be carried out directly on the watchholder.



5



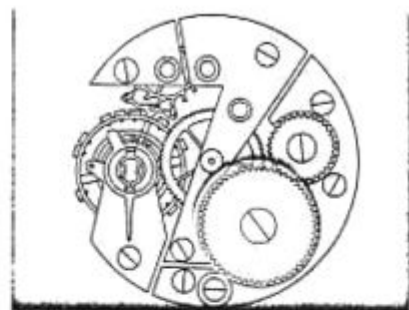
Damaged tooth on escape wheel

When an irregularity recurs in every fifteenth mark of one of the vibrogram lines, this means that one of the fifteen teeth of the escape wheel is damaged.

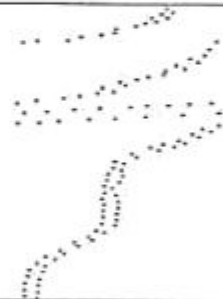
The irregularity frequently appears on both lines of the vibrogram.

Correction

Change the escape wheel.



6



Over-motion

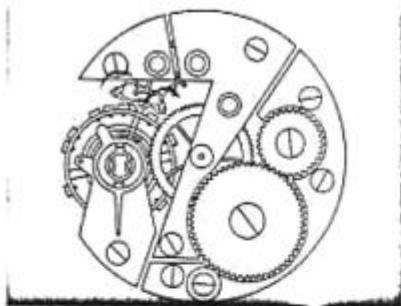
The appearance of the vibrogram in this case is that of a "staircase".

However, as the "bumping" is not always continuous, the vibrogram may also be composed of normal patterns of marks and completely irregular patterns whose scattered marks correspond to the excessively fast rate caused by over-motion.

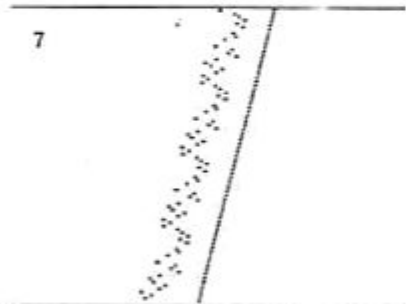
This sort of vibrogram can be produced by an escapement which "catches".

Correction

Replace the mainspring with a weaker one. Proper adjustment and matching of the escapement.



7



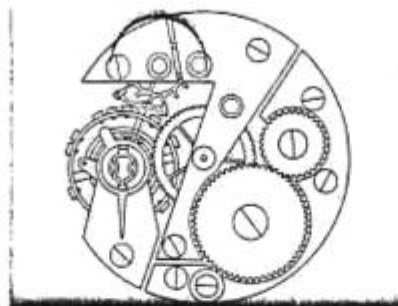
Faulty escapement or damaged pallet stone

The vibrogram is composed of two lines, one of which is regular and the other badly printed with the marks out of alignment.

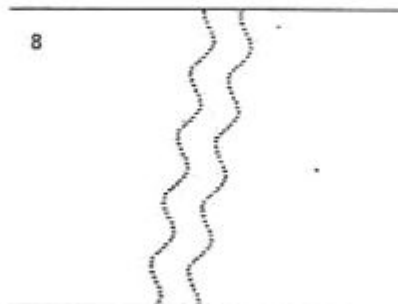
This signifies that only one of the two pallets of the escapement is working properly.

Correction

Check the roller jewel, the pallets, the impulse face or the unlocking angle which may be incorrect on one of the pallet stones.



8



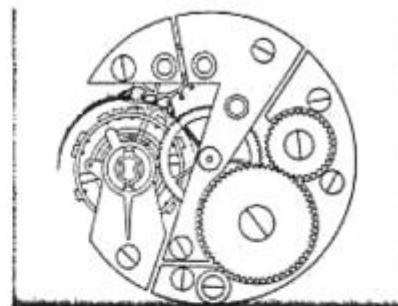
Escape wheel out of round and/or magnetism

The vibrogram consists of two lines with waves occurring at regular intervals. The fifteen marks between the maximum point of one wave and that of the next correspond to a single turn of the escape wheel, which has fifteen teeth. We may conclude that the escape wheel is out of round.

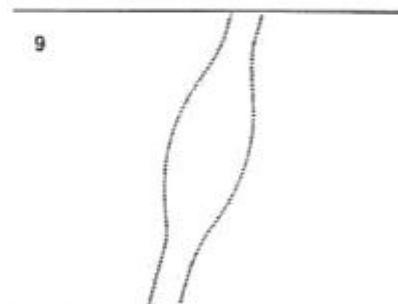
A similar vibrogram may be produced by severe sideshake on the escape wheel pivots, or a bent escape wheel pivot.

Correction

Demagnetize. Check the sideshake on the pivots or if necessary change the escape wheel.



9



Variation in balance motion

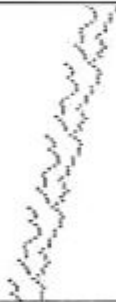
When there is a variation in the distance between the two lines of the vibrogram, this signifies that the motion of the balance varies, the latter not being isochronous.

Correction

Check the jewels and balance pivots, the lubrication, train freedom, and all the usual causes of motion variation.



10



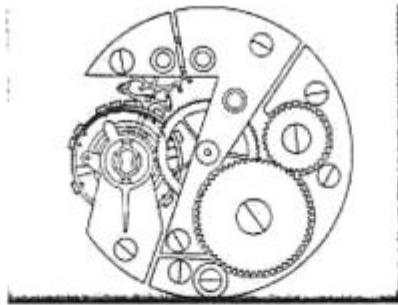
Dirty escapement or irregular transmission and/or magnetism

A completely irregular vibrogram is the result either of a dirty escapement or of irregular transmission of power, i.e. lack of oil, binding of train, or a wide mainspring.

In this case it is advisable to continue the recording for some time and to see whether the vibrogram presents more precise characteristics.

Correction

Demagnetize. Clean and oil the movement, check the sideshake on the pivots and see that the time-train functions properly.



11



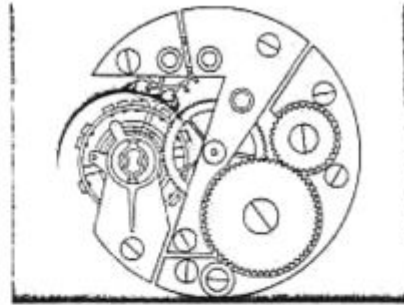
Balance-hairspring not isochronous

When the slants of the vibrogram differ widely between the horizontal and vertical positions, or between the various degrees of mainspring wind, this means either that the isochronism is inadequate or that the play of the hairspring between the curb-pins is too great.

Correction

Check whether the freedom of the hairspring between the regulator pins is not too great, whether the escapement is functioning normally and whether the balance pivots and jewels are in good condition.

The problem of isochronism is very important and at the same time very complex. It is therefore advisable to consult the manuals referred to on page 4.



12



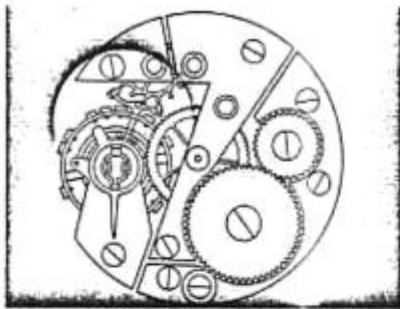
Balance out of poise

If the vibrogram swerves sharply during the change-over from the horizontal to the vertical position or vice-versa, it means that the balance is not in poise.

This defect can also be combined with an isochronal error.

Correction

Bring the balance into poise, or else replace it with a complete balance which has been vibrated, pinned, and poised. If there is also an isochronal error, proceed as indicated above.



13

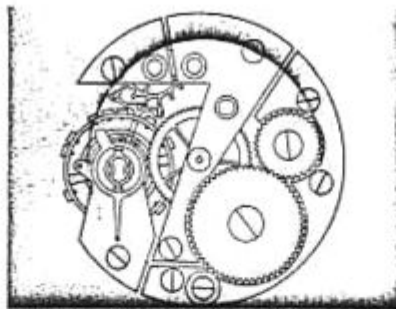


Excessive sideshake on the pallet-arbor or balance pivots, or defective train and/or magnetism

When the vibrogram takes the form of an irregular wavy line, it is usually the result of excessive sideshake on the pallet-arbor or balance pivots, or of a defective train, or any combination of these defects.

Correction

Demagnetize. Check the sideshake on the pivots and replace the faulty parts, if any.



14



Variation in motion of balance, poor transmission, loss of motion and/or magnetism

If the vibrogram is a long wavy line, it generally means that the balance motion is irregular owing to a variation in the driving power.

In order to locate the defect, continue the recording over a long period, with the paper moving slowly. Set paper lever at $\frac{1}{4}$ speed. The frequency of the maximum points of the wavy line will indicate the faulty wheel.

Correction

Demagnetize. In every case it is advisable to begin by dismantling the movement and cleaning and oiling it thoroughly; then check the sideshake of the pivots and the condition of the jewels. Replace any moving part that the vibrogram shows to be defective.

Uses of the Vibrograf

In addition to checking the rate and detecting defects, the Vibrograf is the ideal instrument for the periodic testing of stock, whether of watches or clocks.

The Vibrograf can be used to test movements equipped with escapements other than the jewelled-lever escapement (Roskopf, cylinder, detent, "tourbillon", etc.).

Accutron® electronic timepieces with a tuning-fork require a special watchholder to obtain a readable vibrogram.

Electric watches can also be tested easily with the Vibrograf, remembering that only the mechanical functions are recorded by the standard watchholder. As it is also recommended to test the electric impulses, a special induction pickup can be supplied on request.

There are other means of recording electric impulses of clocks or watches, but it is advised to keep to the instructions of the supplier of the movements, or to consult an official Vibrograf service agent.

The Vibrograf can also be used with an earphone for acoustical tests.

Helpful reminders

Here are some reminders for the watchmaker who wishes to achieve the best results from his Vibrograf.

1

When the Vibrograf is installed, make certain it is placed on a solid table or mounting and far enough away from any noises which could influence the record (motors, typewriters, air compressors, ultrasonic machines, etc.). Care must also be taken to allow sufficient ventilation so as not to obstruct the air slits on the machine.

2

Remember that the information given on the vibrogram (as regards the line quality) may be inaccurate if the watch is badly placed on the microphone.

3

Find the best setting for the volume control by starting at minimum volume and increasing until the correct line appears. If scattered marks appear instead of a line, the machine is not properly set for the beat of the watch; the correct setting must be found by operating the push-buttons for beat selection.

4

When interpreting a vibrogram of unusual appearance, remember that a watch may have several defects at the same time, each one having its own particular influence on the marking.

5

Avoid preconceived ideas when interpreting vibrograms. Use this booklet as a guide.

6

To be able to draw valid conclusions on the subject of isochronism, it is necessary to make several recordings in the horizontal position, gradually increasing the degree of mainspring wind: e.g. one turn, two turns, four turns and fully wound.

7

Faulty poise of the balance does not affect the rate in horizontal positions;

in vertical or oblique positions it exaggerates any isochronal error. Vertical or oblique positions must be used when attempting to poise by rate.

8

Vibrograms should be made before and after each adjustment; it is then possible to see, by comparing the two records, whether the adjustment has had the desired effect.

The Vibrograf® is a product of
Portescap, makers of the famous
Incabloc® shock-absorbers for
watches.

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