

Breitling

CHRONOMAT



FOR SPORT, ETC:

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**FOR COMMERCE
AND TECHNIC:**

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GENERAL DESCRIPTION*of the Breitling Chronomat*

The dial of the Breitling Chronomat differs from the dial of an ordinary chronograph by the absence of the scales for the tachometer, telemeter and pulsimeter. These are replaced by two scales, one on the outer edge of the dial, the other on the rotary bezel. • When suitably set, these scales allow all mathematical calculations to be solved in connection with : a) the time recorded on the dial by the stop-watch hand, b) all kinds of commercial and technical problems. • In addition, the Breitling Chronomat, like ordinary chronographs, has the usual stop-watch divisions of seconds and fifths of a second.

Reading the scales

The inner scale (the one on the dial) is read counterclockwise, whilst the outer scale (on the rotary bezel) is read clockwise (see the arrow). These scales are read in the same way as the scale of a thermometer. The small strokes between two numerals (for instance between 2 and 3) represent one-tenth, i.e. 2.1, 2.2, 2.3, etc.

Evaluating the numbers

Only units are given on the scales, so that all decimals must be neglected when adjusting the scales. On the other hand, when reading the result, the decimal point must be correctly inserted, a number of 0's being added before it if necessary. A little practice will soon make perfect in this respect.

Example: *The figure 32, for instance, means 3,2 km. per hour for a walking pace, 32 km. per hour for a cycle race and 320 km. per hour for the speed of aeroplanes.*

TACHOMETER

Aim : to determine the speed of a runner, vehicle, aeroplane, a movement, etc.

The tachometric divisions of ordinary chronographs can seldom be put to any practical use, but the Breitling Chronomat allows all tachometric calculations to be made, whatever may be the distance traversed or the time taken.

Method of using

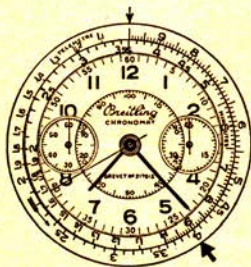
On the inner scale will be found 4 red marks : 1/5 (on the figure 18, since there are 18,000 one-fifths of a second in 1 hour); S (on the figure 36, since there are 3600 seconds in 1 hour); Minutes (on the figure 6, since 60 minutes = 1 hour); H (on the figure 1, the hour being the basic unit for all calculations).

General rule

Always set the length of the distance traversed opposite the corresponding mark serving as basis of the calculation :

at 1/5 if the chronograph time is read in 1/5th secs.
at S if the chronograph time is read in seconds
at Minutes if the chronograph time is read in min.
at H if the chronograph time is read in hours

The time of a chronographic observation is obtained by starting and stopping the large stop-watch seconds hand by means of the upper knob. That time is then converted into $1/5$ th seconds, minutes or hours, in accordance with the mark chosen and used as unit for the calculation.



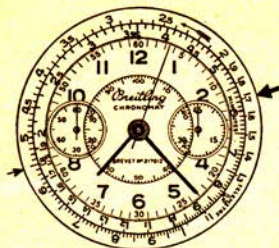
Examples :

PROBLEM

1

A motorcar runs 1 km. in 40 sec. What is its speed in km. per hour ?

Solution : 1 (the distance traversed) is set opposite the mark S (since the chronograph records the time in seconds). 4 (40 seconds duration of running) coincides with 9. Result : 90 km. per hour.

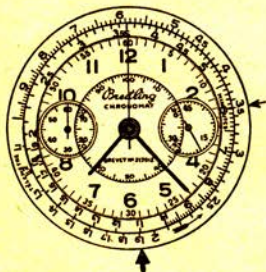


PROBLEM

2

A skier makes a jump of 55 metres in $3 \frac{2}{5}$ seconds. What is his speed per hour during the jump ?

Solution : Set 55 (length of jump) opposite the mark $1/5$ ($1/5$ th = time unit). $3 \frac{2}{5}$ sec. = 17 fifths of a sec. 17 and 58 coincide, giving the result 58 km. per hour.

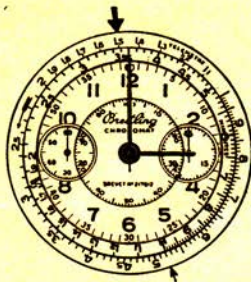


PROBLEM

3

A runner takes 19 minutes to cover 3.5 km. What is his speed per hour?

Solution: Set 35 (3.5 km.) opposite the mark « Minutes » (time by chronometer). 19 (time taken for the distance) coincides with 11. The speed per hour is therefore 11 km.



PROBLEM

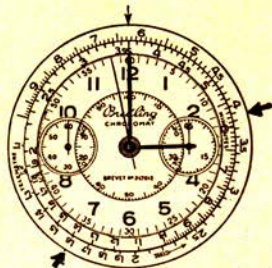
4

A walker covers 52 km. in 15 hours. What is his speed per hour?

Solution: Set 52 (52 km.) opposite the mark H (time measured in hours). 15 (distance traversed) coincides with 34.6 (the 0.6 is estimated). Speed per hour: 3 km. 460 m. This is a characteristic example of the placing of the decimal point.

An important advantage of the Breitling Chronomat

When present at a race meeting, set once for all the number representing the length of the track, placing it opposite the mark that has been chosen for the chronometric observations (seconds, minutes, etc.). The scale now gives the speed of the competitors after each round in accordance with the timing by the chronograph.



Example :

PROBLEM

5

Length of track : 6 km. 250 m.

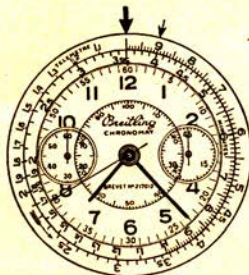
Lap in 58 secs. = 388 km. per hour.

Lap in 2 min. 40 sec., i.e. 160 sec., = 140 km. per hour.

These examples are obtained with the scale set to the mark S (seconds).

The Breitling Chronomat also allows the length of a track

to be estimated when only the speed is known at which this track is covered. It is then sufficient to make the inverse calculation to the foregoing.



PROBLEM

6

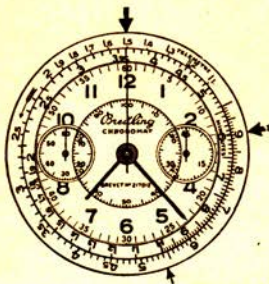
(Example No. 1, page 6, in the inverse sense.) • A motorcar runs for 40 seconds at a speed of 90 km. per hour. What distance does it cover ?

Solution : Set 90 (speed) to coincide with 40 (time elapsed). Reading at the mark S (the time unit being in seconds) gives the result 1, i.e. distance covered = 1 km.

Converting

**km per hour into
metres per minute or
metres per second**

In certain cases (in the army, with homing pigeons, etc.) such conversions may be useful.



PROBLEM

7

Convert 54 km. per hour into metres per min. and metres per sec.

Solution: Set 54 opposite the mark H (hours). Read at the mark « Minutes »: 9, i.e. 900 metres per min., and at the mark S: 15, i.e. 15 metres per second.

C Y C L I N G

Using the Breitling Chronomat to time the speed of cyclists.

Method of using

The following bases of calculation are indispensable:
1. Size of the different gears (i.e. distance traversed for each complete turn of the cranks); 2. Time for 10 turns of the cranks.

Example:

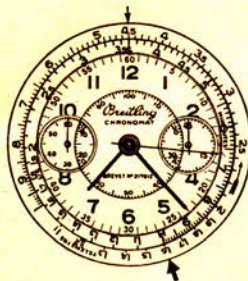
PROBLEM

8

A cyclist uses a gear of 4.5 m. What is his speed per hour?

Solution: 45 (size of the gear) is set opposite the mark S (seconds). When 10 turns of the pedals are made in 16 secs., the result is obtained at the figure 16, i.e. 1, or a speed of 10 km. per hour.

Note: When starting the chronograph, take care to starting counting mentally with zero and not with 1.

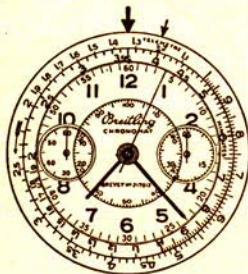


TELEMETER

Aim: Determining the distance between two points connected by light and sound (distance from a flash of lightning, the position of a cannon, a ship, etc.).

Method of using

By setting the mark «Telemeter» (red on the outer scale) opposite the number representing the time noted, read the distance traversed by the sound at the mark S seconds, when the time is noted in seconds).



Example:

PROBLEM

9

A peal of thunder is heard 4 seconds after seeing the lightning. How far away was the lightning?

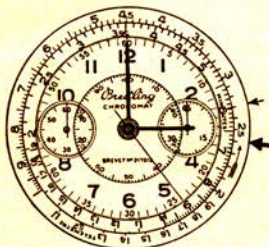
Solution: Set the mark «Telemeter» opposite 4 (4 seconds). At the mark S read 13.3 (0.3 estimated). Distance from the lightning = 1 km. 330 m.

PULSIMETER

Quick calculation of the rate per minute of a patient's pulse.

Method of using

Opposite the mark «Minutes» (the result is desired in minutes) set the counted number of pulse beats, and read opposite the time of observation (in seconds) the number of pulse beats per min.



Example:

PROBLEM

10

A doctor counts 27 pulse beats in 24 seconds. What is the rate per minute?

Solution: Set 27 (pulse beats) opposite the mark «Minutes». The desired result is read opposite 24 (observed time). Result: 67 pulse beats per minute.

Important remark: When counting pulse beats, one is tempted to start counting «1» when depressing the knob of the stop-watch. Remember on the contrary that the watch starts at «0».

M E T R O N O M E

Checking beats :

Method of using

Procede as for the Pulsimeter.

Example :

PROBLEM

11

8 beats are made in 7 seconds. How many does that represent per minute?

Solution : Set 8 (the number of beats) opposite the mark « Minutes ». The desired result is to be found opposite the number 7 (observation time), i.e. 68 beats per minute.

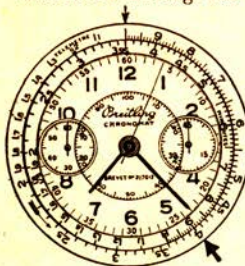
Important remark : Take care not to start counting 1 when depressing the knob of the stop watch. That time is, on the contrary, equivalent to « 0 ».

P R O D U C T I O N C O U N T E R

Calculating the production per minute, per hour, etc.

Method of using

Set the figure 1 of the outer scale opposite « S » when the time is noted in seconds, or opposite « Minutes » when the time is noted in minutes. The production per hour is then read opposite the figure representing the number of parts manufactured during the observation time.



Example :

PROBLEM

12

A machine produces 4 finished parts in 1 second. What is the rate of production per hour?

Solution : Set the figure 1 opposite the mark S. Opposite 4 the result can be read, i.e 900 parts in the hour.

METEOROLOGY

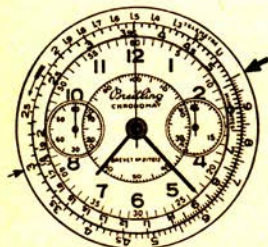
According to the height of a cloud the distance which it passes between 2 teeth of a nephoscope frame can be measured. The estimated height of a cloud is 10 times greater than the observed distance passed through. Consequently set the figure 5 to the mark S (seconds) when the assumed height of the cloud is 5000 m. and the observation time 24 seconds. Its speed is then 75 km. per hour, since 24 coincides with 75.

COUNTING HOURS

If a period of several hours is to be timed, it is sufficient to set the mark «1» of the rotary bezel opposite the hour hand. This will serve to fix the hour at which timing started.

MULTIPLICATION

Set the multiplicand opposite the multiplier. The result is then read opposite the «1» on either of the scales.

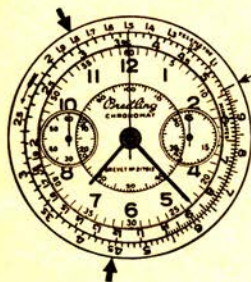


Example:

$$3 \times 18 = 54$$

DIVISION

Division is the inverse of the previous example. Setting the number «1» of either scale opposite the dividend, a complete division table for this number is obtained, the result of dividing by any other number being read opposite the divisor, i.e. each divisor coincides with the result.



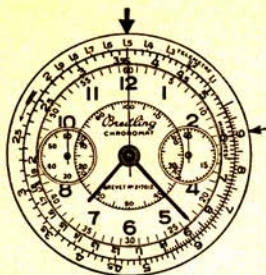
Example:

$$54 : 18 = 3.0$$

$$54 : 45 = 1.2$$

RULE OF THREE

From the preceding two rules it will be seen that multiplying and then dividing can be performed on the Breitling Chronomat in a single operation.



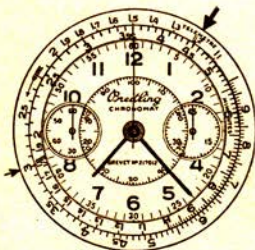
PROBLEM

14

- If 1.5 metres (1)
costs Fr. 9.— (2)
6 metres will cost (3)
X (4)

Solution: Set (2) and (3), i.e. Fr. 9.— and 6 metres opposite each other and read the solution of the problem (4) opposite (1) i.e. opposite 1.5 m. Result: 6 metres cost Fr. 36.—.

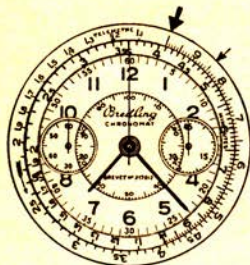
The difficulty consists in setting the problem correctly. Note that the terms (1) and (3) are similar («metres» in problem 14) and that the terms (2) and (4) will also be similar («francs» in problem 14). Consequently the terms (1) and (4) differ in nature. Therefore we set the metres as first term on the scale when we desire the result in francs, and vice versa. The middle terms which we set opposite each other, (2) and (3), also differ in nature.



Example:

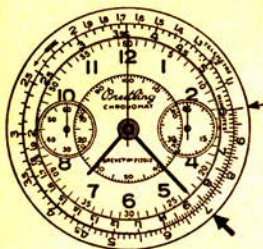
$$\frac{3 \times 18}{12} = 4.5$$

PERCENTAGES



Calculating percentages is an ordinary rule of three and the procedure is the same as above, for instance, what is 85 per cent of 48. • In fact, if 100 % becomes 85 %, 48 hours becomes X. It is then sufficient to multiply 85 by 48 and to read the result, 41, opposite the « 1 » on either of the scales.

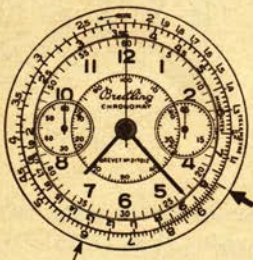
PRIME COSTS



I. A merchant desires to make 30 % on the selling price of an article. Consequently he must sell at Fr. 100.— if he has paid Fr. 70.— What is the selling price of an article which costs him Fr. 6.— ?

Solution : Set the purchase price opposite « 1 » and read the result, Fr. 8.60, opposite 70. In fact, 8.60 less 30 % = Fr. 6.—.

II. A merchant desires to make 30 % on the purchase price of an article. Consequently he must sell at Fr. 130.— if he has bought at Fr. 100.—. To obtain the selling price, the purchase price has to be multiplied by 130 (100 % purchase price + 30 % profit on the prime cost) and divided by 100.



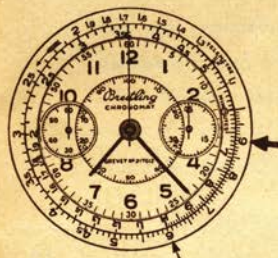
PROBLEM

15

An article costs Fr. 6.—. At what price must it be sold to make 30 % profit on the prime cost ?

Solution : Set 6 opposite 13 (130 %) and read the result, Fr. 7.80, opposite the « 1 » of either scale.

III. Here is a more complicated example following on the two preceding problems :



PROBLEM

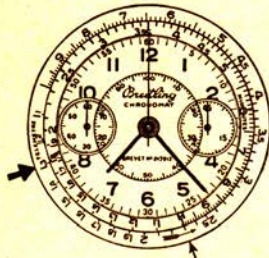
16

Goods are purchased at Fr. 6.— per kg. gross. The packing weighs 10 % of the total. What is the net cost of the goods ?

Solution : Set 6 (Fr. 6.—) opposite the « 1 » of a scale and read the result opposite the 9 (900 grams), i.e. Fr. 6.70 per kg. net.

FUEL CONSUMPTION

Calculating the fuel consumption of a motorcar per 100 km.



PROBLEM

17

A motorcar uses 23 litres of petrol for a journey of 130 km. What is the fuel consumption per 100 km.?

Solution: Set the number of litres (23) opposite the «1» of either scale and read the required result opposite the number representing the distance run by the car, i.e. a consumption of 18 litres per 100 km.

CALCULATING INTEREST

Do you remember the method of « interest numbers » and « fixed divisors »? By setting « 1 » to the mark « S » (360 days = 1 commercial year) a table of these « fixed divisors » is obtained :

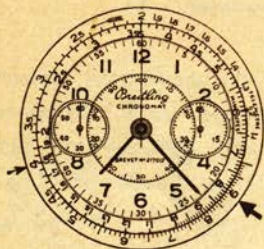
4 0/0,	fixed divisor	90
5 0/0,	»	72
6 0/0,	»	60
etc.,	etc.	

Multiply the capital by the number of days, then divide by the « fixed divisor ». The result is found opposite the « fixed divisor » (principle of the rule of three).

(See example overleaf.)

CONVERTING RATES OF EXCHANGE

Setting the «1» on one scale opposite the «1» on the other, a table is obtained which allows rates of exchange to be converted.

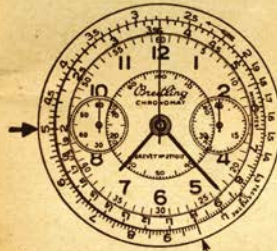


PROBLEM

18

What is the interest on Fr. 400.— for 180 days at 4% p.a.?

Solution: Set 4 (Fr. 400.—) opposite 18 (180 days) and read opposite 9 (90 = «fixed divisor» for 4%) the required result, Fr. 8.—.



PROBLEM

19

If Fr. Fr. 100.— are quoted at Sw. Fr. 5.— at Zurich, what is the rate of exchange, i.e. how many French francs can be obtained for Sw. Fr. 100.—?

Solution: Set the «1» of one scale opposite the «1» of the other, and read the result desired opposite 5 (rate of exchange of the French franc) = 2000. Sw. Fr. 100.— are consequently worth Fr. Fr. 2000.—.