BREITLING
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NAVITIMER

Official Timepiece of the Aircraft Owners' and Pilots' Association (A.O.P.A.)

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Contents

General description

The Navitimer is a precision instrument combining the best features of a navigator's stop watch with a time-speed-distance flight computer similar to those with which most pilots are familiar.

In addition to the conventional watch face encompassing a standard hour and minute hand and a second hand, the Navitimer features a sweep second hand which can be controlled by use of a push button in the same manner as a stop watch.

The top push button will activate the second hand which will remain in motion until the same push button is again pressed. The second hand may then be reset by depressing the lower push button, or the time accumulation may be continued by again pressing the top button.

In this manner a pilot may accumulate flight time involving two or more intermediate landings, by starting the

sweep second hand on initial take off, stopping it when landing at the first airport and starting it when ready to leave on the second take off. The time recorded in this manner on the minute and hour accumulation dials which are found to the right of the center of the watch and immediately below the center of the watch respectively, will show the total flight time less the amount of time spen on the ground at refueling points or intermediate stops.

It might help explain it a little more clearly if you consider that one revolution of the sweep second-hand is equal to one notch on the small minute hand (upper right-hand dial), one complete revolution of that minute hand is equal to one notch on the hour on the small hour dial bottom), and one complete revolution of that small dial is 12 hours. The small dial at the upper left is just an ordinary second-hand that runs all the time the watch is running.

The computer portion of the watch will require a little time and patience to master, if the pilot is unfamiliar with standard flight computers. It is actually a circular slide

rule and will make accurate computations involving multiplication and division in terms of time, distance, fuel consumption and other normal flight and navigation computations dealing with speed, time and distance.

Inspection of the watch will reveal that there is a white outer disc in the form of a movable bezel on which will be found numbers running from 10 to 10. (The figure "10" may be 1.0, 10., 100., or 1.). In these instructions we will refor to this as the white disc. On the outer perimeter of the face of the watch there is a second similar disc which whe shall refer to as the black disc.

Note that the white disc will always be related to miles, or miles per hour, feet, or feet per minute, gallons, or gallons per hour, or any quantity which varies with time. The black disc deals with minutes or hours in all problems involving time.

At 60 minutes on the black disc there is an arrow which is marked "MPH." This is sometimes known as the "ground speed index" or "hour index". This index is used in problems involving any quantity per hour. The black disc contains a double time scale for the added con-

venience of pilots flying long distances. Thus it is possible to compute fractions of the hour in terms of 7 minutes, 12 minutes, 45 minutes, etc., on the outermost portion of the scale and to also compute time when it is in excess of one hour by dropping down to the inner portion of the scale. Thus, it will be noted that above the hour eleven on the outer scale of the black disc will be found the number 55. This indicates 55 minutes. Directly to the right will be found the ground speed index arrow which is at the 60 minute or one hour point of the disc. Now look on the lower scale directly to the right and you will find "1 : 10" indicating an hour and 10 minutes. The increments which follow indicate 1 : 20, 1 : 30, etc., all the way up to ten hours.

Operation as an ordinary slide rule

For those who are accustomed to using an ordinary slide rule, it should be noted that the black and white scales of the Navitimer can be used as the "C" and "D" scales of the ordinary slide rule. Problems of multiplication, division and proportion may be solved readily by using the computer in this manner. For those not accustomed to the use of the slide rule, the decimal point is determined by inspection. The figure 10 may be 1.0., 10., 100., or 1. The problem will usually be such that the decimal point is easily determined. For instance, if in a problem concerning air speed the answer is 15 on the computer, it would be obvious that the air speed would be 150 miles per hour, rather than 15 miles per hour.

To multiply

Example 1.

To multiply with the Navitimer use the unit index (number "10" on the outer black dial). Always set the *multiplier* (the number by which another is multiplied) opposite the unit index on the outer black dial and rad the *answer* on the white disc opposite the *multiplicand* (number to be multiplied by another) appearing on the outer black dial.

To multiply 7 × 12, set 12 (the multiplier) on white dial opposite unit index ("10") on the black disc. Opposite 7 (the multiplicand) on the outer black disc read the answer 84 on the white dial.

To divide

Example 2.

To divide with the Navitimer also use the unit index.
Place the *dividend* (the *quantity* to be divided by another number) on the white disc opposite the *divisor* (quantity by which another is divided) on the black disc. Opposite the unit index (numeral "10" on black disc) read answer on white disc.

Divide 160 by 4. Place 16 on white disc opposite 4 on the black disc. Read answer, 40 on white disc opposite unit index (numeral "10" on black disc).

Ground speed

The white and black scales are used for determination of ground speed problems. Two of the following quantities are available for its solution : time, distance, ground speed.

Example 3.

Known : Distance and Time.
Required: Ground speed.
A pilot finds by the use of check points that he has traveled 104 miles in 35 minutes.

Solution : Move the white dial until 104 on the white scale is set opposite 35 on the black scale. Opposite the hour index (the arrow marked "MPH" directly over the hour 12) read 178 miles per hour on the white scale.

Example 4.

Known : Distance and speed.
Required : Time.
A pilot wants to know how long it will take to go 486 miles at a ground speed of 156 miles per hour.

Solution : On the white disc set 156 opposite the hour index on the black scale. On the outer black scale opposite 486 on the white scale read 187 minutes (or 3 hours and 7 minutes on the inner black scale).

Example 5.

Known: Time and speed.
Required : Distance.
A pilot wants to know what distance he will travel in 28 minutes traveling at a ground speed of 148 miles per hour.

Solution : Opposite the hour index on the black dial set 148, on the white dial. Opposite 28 on the black dial read 69 miles on the white dial. (Note : It is not necessary to reset the computer after having once determined speed). Thus, in Example 5 above, the pilot may determine the distance traveled in 46 minutes without changing the setting and by merely looking opposite 46 on the black dial for the distance 113½ miles on the white dial.

Miles per minute

This may be read after the speed in miles per hour has been obtained. The speed given in miles per hour on the white dial when set opposite the hour index on the black dial can be readily converted into miles per minute by reading the number on the white dial appearing opposite the figure "10" on the black dial. The figure "10" is often referred to as the unit index.

Example 6.

In Example 4, the ground speed was 156 miles per hour. With the 156 on the white dial set opposite the hour index, what is the speed in miles per minute ?

Solution : With 156 miles on the white dial set opposite the hour index read the speed in miles per minute, or the figure on the white disc which appears above the figure "10" on the black disc which is 2.6 miles per minute.

There are times when a pilot may want to know the time required to travel a short distance, such as the distance from the cone of silence to the edge of an airport, or between the inner marker and range station. Since the distance is short, the time required may be less than a minute, in which case the time has more significance when expressed in seconds. In such cases the "second" index is used. This is the figure "36" on the outer black dial (there are 3600 seconds in an hour). The following example illustrates this problem.

Example 7.

Known : Miles per hour and distance.
Required : The number of seconds to cover the distance.
A pilot is approaching the airport at a ground speed of 120 miles per hour. The fan marker is 1½ miles from the edge of the field. The pilot wants to know how many seconds will lapse after crossing the marker before he is over the edge of the field.

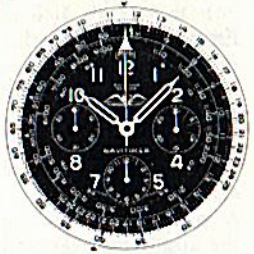
Solution : Set 120 on the white dial opposite 36 (the second index) on the outer black dial. Opposite 1.5 on the white dial read 45 seconds on the outer black dial.

Gasoline consumption

Two of the following quantities are available for gasoline consumption problems: Total gallons used, time, rate of consumption.

Example 8.

Known: Time and rate of consumption.
Required: Total gallons used.
A pilot wishes to know how many gallons are necessary to fly 3½ hours at an average rate of consumption of 11½ gallons per hour.



Solution: Opposite the "hour index" set 11.5 on the white disc. Then, opposite 3½ hours on inner black scale (210 minutes on outer black scale) on the white scale read 41 gallons.

Example 9.

Known: Total gallons and rate of consumption.
Required: Time.
A pilot has 60 gallons aboard. How long will it last at an average rate of consumption of 12½ gallons per hour?

Solution: Opposite "hour index" set 12½ on white disc. Opposite 60 on the white disc read 288 minutes (or 4 hours and 48 minutes).

Example 10.

Known: Total gallons used and time.
Required: Rate of consumption.
After flying 145 minutes (2 hours 25 minutes) a pilot notes that he has used 27½ gallons of gasoline. What is the rate of consumption?

Solution: Set 27½ gallons on the white disc opposite 145 minutes on the black disc. Opposite the "hour index" read the rate of consumption which is 11.3 gallons per hour.

Note: If your aircraft has a flowmeter, the rate of fuel consumption may be found by dividing the total flow (in pounds per hour) by 6 (because 1 gallon weighs about 6 pounds). On your Navitimer place the number of pounds per hour on the white disc opposite the "hour index" on the black disc and read answer on the white disc opposite the "unit index" (unit index is figure "10" on outer black disc).

Rate of descent (or climb)

Two of the following are available for solution: total altitude of descent, time and rate of descent (or clim).

Example 11.

Known : Time and rate of descent.
Required : Total elevation of descent.
A pilot is descending at the rate of 300 feet per minute. What will be his loss of altitude after descending for 34 minutes ?

Solution : Set 30 (= 300) on the white disc opposite the "unit index" (the numeral "10") on the black disc. Now opposite 34 on the black disc read 10,200 feet on the white disc.

Example 12.

Known : Time and total elevation.
Required: Rate of climb.
A pilot climbs 6900 feet in 15 minutes. What is his rate of climb or ascent ?

Solution : Opposite 15 on the black disc set 6900 on the white disc. Opposite "unit index" ("10" on black disc) read rate of ascent as 460 feet per minute on white disc.

Example 13.

Known : Rate of ascent and total elevation in ascent.
Required : Time.
A pilot climbs to 7400 feet above his starting point at the average rate of 500 feet per minute. How long will this require ?

Solution : Set 500 on the white disc opposite the "unit index" ("10" on the black disc). Opposite 7400 on the white disc, read answer, 14.8 minutes on the black disc.

Distance in climb or descent

Two of the following quantities are available: Distance, time, speed. The method used in examples *4*, *5* and *6* should be used.

Example 14.

The pilot in example *13* wishes to know how far he will have traveled when his climb is finished. His average true air speed is 120 miles per hour and he is aided by a tail wind of 20 miles per hour.

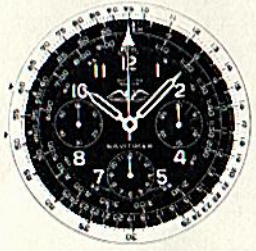
Solution : Set 140 miles per hour (120 + 20) on white disc opposite "hour index" on black disc. Opposite 14.8 minutes (computed from example *13*) on black disc read 34.5 miles on white disc.

Nautical and statute mile conversion

On the black disc both Nautical (Naut.) and statute (stat.) miles are shown, also kilometers (KM).
The conversion from statute to nautical or nautical to statute is read directly on the white disc.

Example 15.

Known: 60 statute miles.
Required: Nautical miles.



Solution : Set 60 on white disc opposite "STAT" on black disc. Opposite "NAUT" on black disc read 52 nautical miles.

Example 16.

Known: 60 statute miles.
Required: Kilometers.

Solution : Set 60 on white disc opposite "STAT". Opposite "KM" on black disc read 96.5 kilometers.