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NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS.

*Technical Memorandum No. 132*

COUTINHO-SACADURA COURSE CORRECTOR.\*

By Sacadura Cabral, "Capt. de Corvette."

From "Premier Congrès International de la Navigation Aérienne," Paris, November 15-25, 1921, Vol.II.

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Memorial Aeronautical  
Laboratory

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## COUTINHO-SACADURA COURSE CORRECTOR.\*

By Sacadura Cabral, "Capt. de Corvette."

The Coutinho-Sacadura course corrector is an instrument with which, knowing the angles of drift of two different courses, we may determine by simple reading:

- a) Direction and velocity of wind;
- b) Correction to be made in course followed by compass, in order to fly in a given direction;
- c) Ground-speed of aircraft, the resultant of its air speed and the velocity of the wind.

This instrument is also very useful in planning a trip, since it renders it possible to determine, by a simple reading, the effect of a given wind in increasing or diminishing the ground speed of the airplane and by how many degrees the course must be corrected by the compass in order to follow a given direction.

The instrument is shown in Fig. 1, where it is assumed that the angles of drift have been determined for two courses differing by  $45^{\circ}$ , but it may be easily changed for determining the angles of drift for any courses flown. It would only be necessary to render the pointer b (with its scale) movable on the arc joining the pivots A and B of the pointers a and b, which is easily done.

The course corrector consists of a board with two pointers

\* Translated from "Premier Congrès International de la Navigation Aérienne," Paris, November 15-25, 1921, Vol. II, pp. 112-114.

a and b, turning about the pivots A and B and provided with fastening screws. Scales  $a'$  and  $b'$ , painted black and running up to  $30^{\circ}$ , make it possible to fasten the pointers at the angles of drift determined. The graduations of scale  $b'$  are marked + and -.

In the sector covered by the pointer a there are drawn:

a) A semi-circumference in black, whose radii, drawn every ten degrees, indicate the direction of the wind. The semi-circumferences, likewise painted black, indicate the velocity of the wind in terms of the air speed of the aircraft considered as unity;

b) Straight lines, painted red, which indicate the correction to be made in the compass course, in order that the airship may follow a given direction;

c) Curves, painted red, which indicate the ground-speed of the aircraft in terms of its air-speed, considered as unity.

In order to render the use of the course corrector extremely practical, it is advisable to make a very simple and very advantageous modification on the aircraft.

Experience in aerial navigation on long voyages over water leads us to remark that, instead of taximeters or other instruments for measuring the drift, it would be better to employ the aircraft itself as a taximeter, which is easily done.

It is only necessary to place near the observer, on either side of the fuselage or nacelle, two small reference points a and b, (Fig. 2), which will be the centers of large circles

whose graduations (every five degrees) are painted on the wings or tail fin, according to whether the observer is in front of or behind the wings. The sign + is painted on the right side and - on the left.

This method is more economical, since it dispenses with the purchase of an instrument for measuring the drift. It is also more accurate, because in reality, it constitutes a large taxi-meter which has the advantage of always being ready and never being in the way.

Let us now see how the course corrector is used, assuming that we are flying over water and employing smoke bombs for determining the drift.

Let AB (Fig. 3) represent the course followed by compass and BC the unknown wind. The first smoke bomb is dropped and, with the airplane exactly on the compass bearing, the pilot makes a sign to the observer. The latter, who has constantly followed the bomb with his eyes, determines the first angle of drift with the aid of the graduation on the wings. This angle is given the sign painted on the wing which served for measuring it.

The pilot then turns the aircraft  $45^{\circ}$  to the windward (It is better to turn to the windward, since the definitive course must be nearer the wind and thus slightly offset the effect of the drift). Another bomb is dropped and the second angle of drift is determined in a similar manner.

Example:-

Air speed of aircraft (speed indicator) 100 km.

First course followed  $30^{\circ}$  NE

First angle of drift  $+13^{\circ}$

Second course followed  $30^{\circ} + 45 = 75$  NE

Second angle of drift  $+17^{\circ}$

The pointers a and b are set on the graduations  $+13$  and  $+17$  and their point of intersection enables us to read the following data:

Direction of wind	$30^{\circ}$ NE + 118 = $148^{\circ}$
Velocity of wind	$0.3 \times 100 = 30$ km/hr.
Correction to be made to first course	$+15^{\circ}$
Course to be followed by compass	$30^{\circ}$ NE + 15 = $45^{\circ}$
Ground speed of aircraft	$1.1 \times 100 = 110$ km/hr.

If the first course has the sign -, the corrector is turned upside down and the signs marked on the bottom are used, which are the opposite of those marked on the top or "face" of the corrector. In this case, the corrections for determining the direction of the wind and the course to be followed will have the - sign. The rule is: "The corrections for determining the direction of the wind and the course to be followed are applied with the sign of the first angle of drift measured."

Thus, by assuming:

First course followed  $30^{\circ}$  NE

First angle of drift  $-13^{\circ}$

Second course followed  $30^{\circ} - 45 = 345^{\circ}$

Second angle of drift -17

We will have:

Direction of wind	$30^{\circ} - 118 = 272^{\circ}$
Velocity of wind	$0.3 \times 100 = 30 \text{ km/hr.}$
Course to be followed	$30^{\circ} - 15 = 15^{\circ}$
Ground speed of airplane	$1.1 \times 100 = 110 \text{ km/hr.}$

In planning a voyage, the corrector is useful, in that it renders it possible, by a simple reading, to obtain an idea of the effect of a given wind.

The wind considered is found by the aid of the black radii and semi-circles.

The straight and curved red lines enable us to determine immediately:

- a) By how many degrees the compass course must be changed (toward the wind) in order to follow the right course;
- b) The ground speed of the airplane.

Thus, wishing to know the effect of a cross wind with a velocity of 0.3 of the air-speed of the airplane; we find that the course to be followed is  $18^{\circ}$  (more exactly, 17.5) nearer the wind. The ground-speed, in following this course, will be 0.95 of the air-speed.

Translated by the National Advisory Committee for Aeronautics.

Dotted-lines represent the red-lines

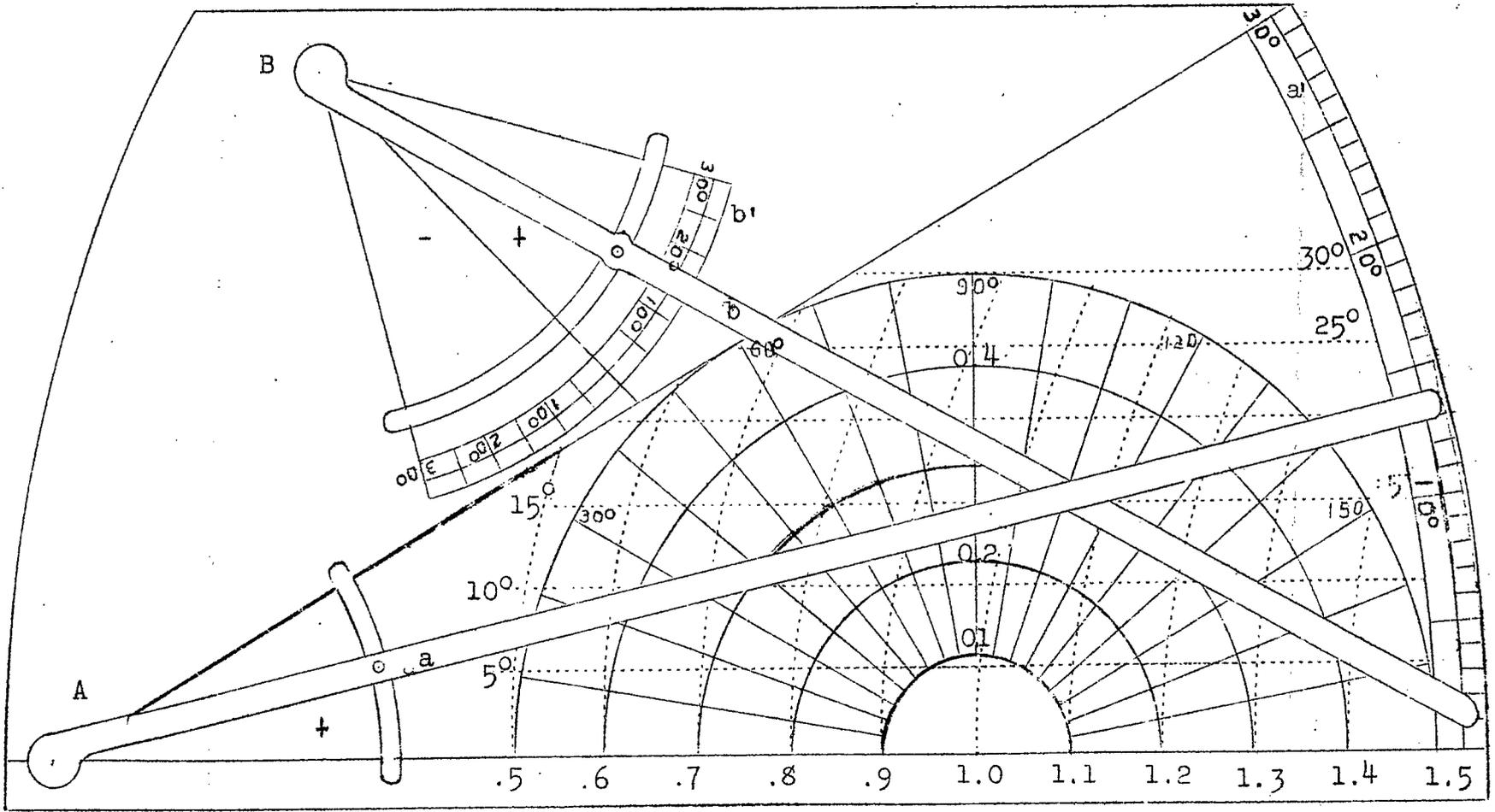


Fig. 1.

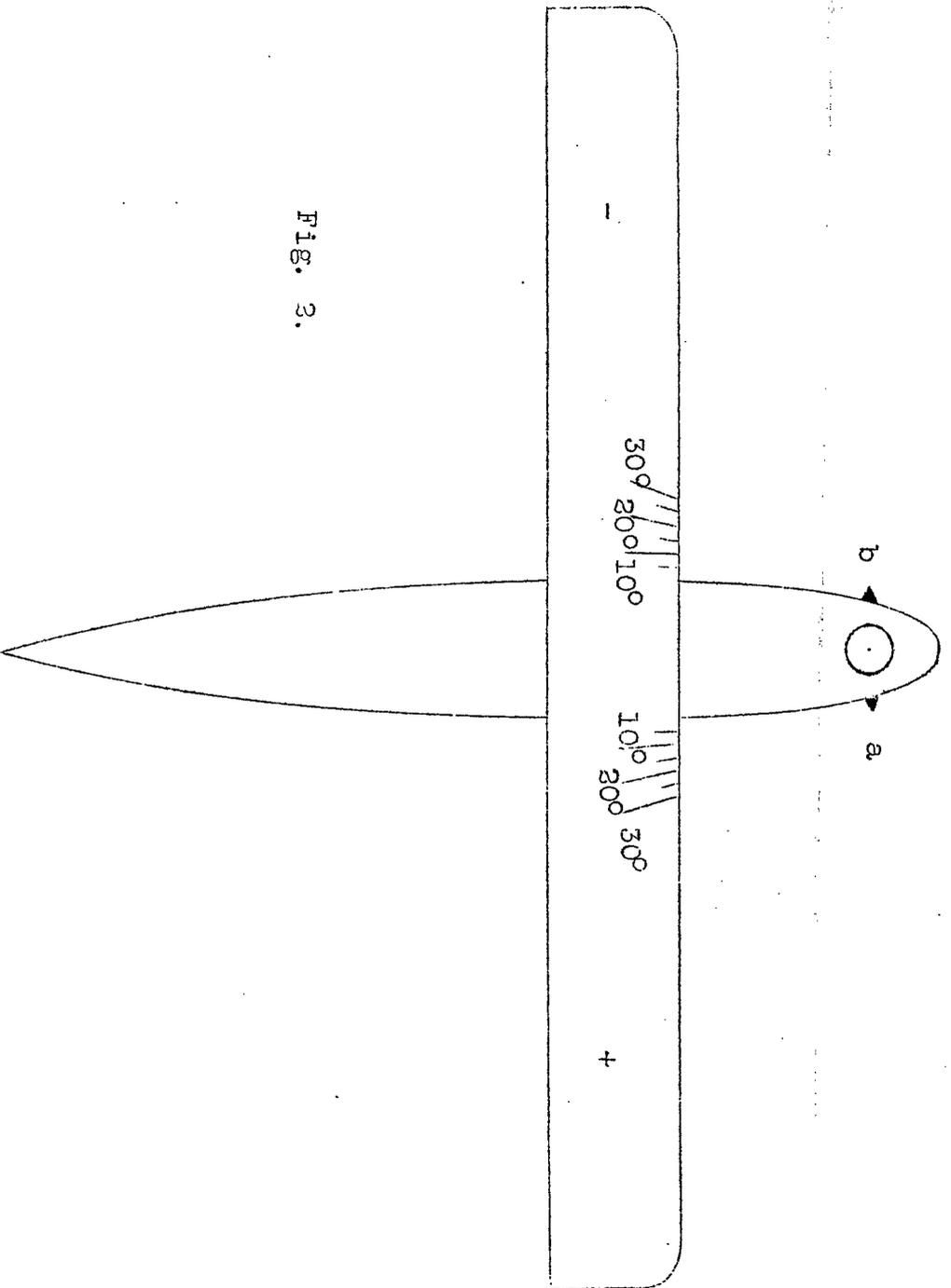


Fig. 3.

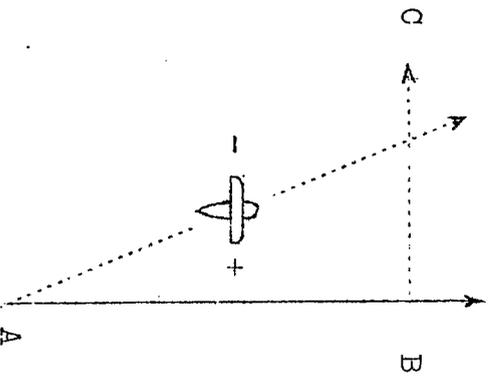


Fig. 3.