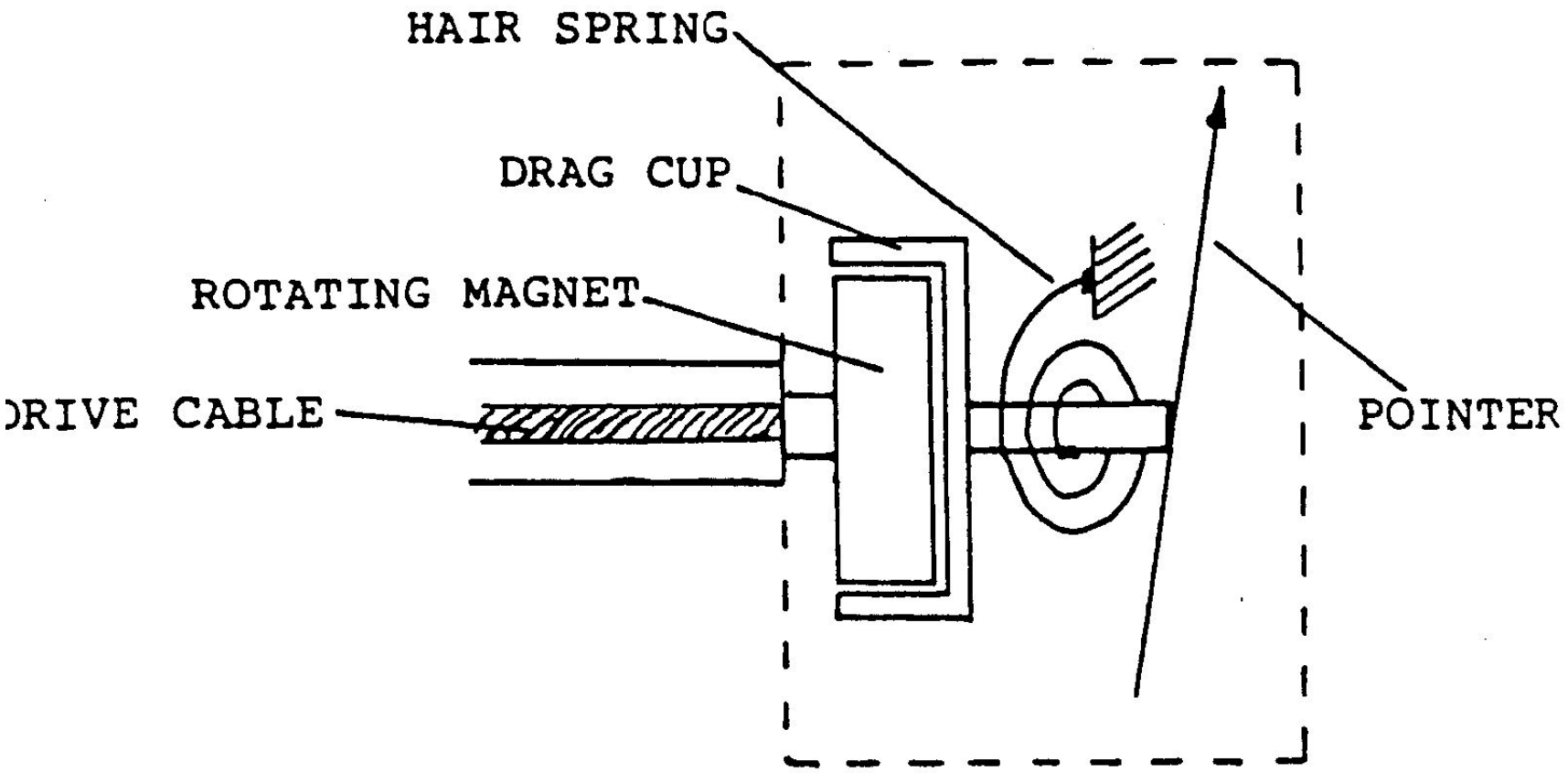
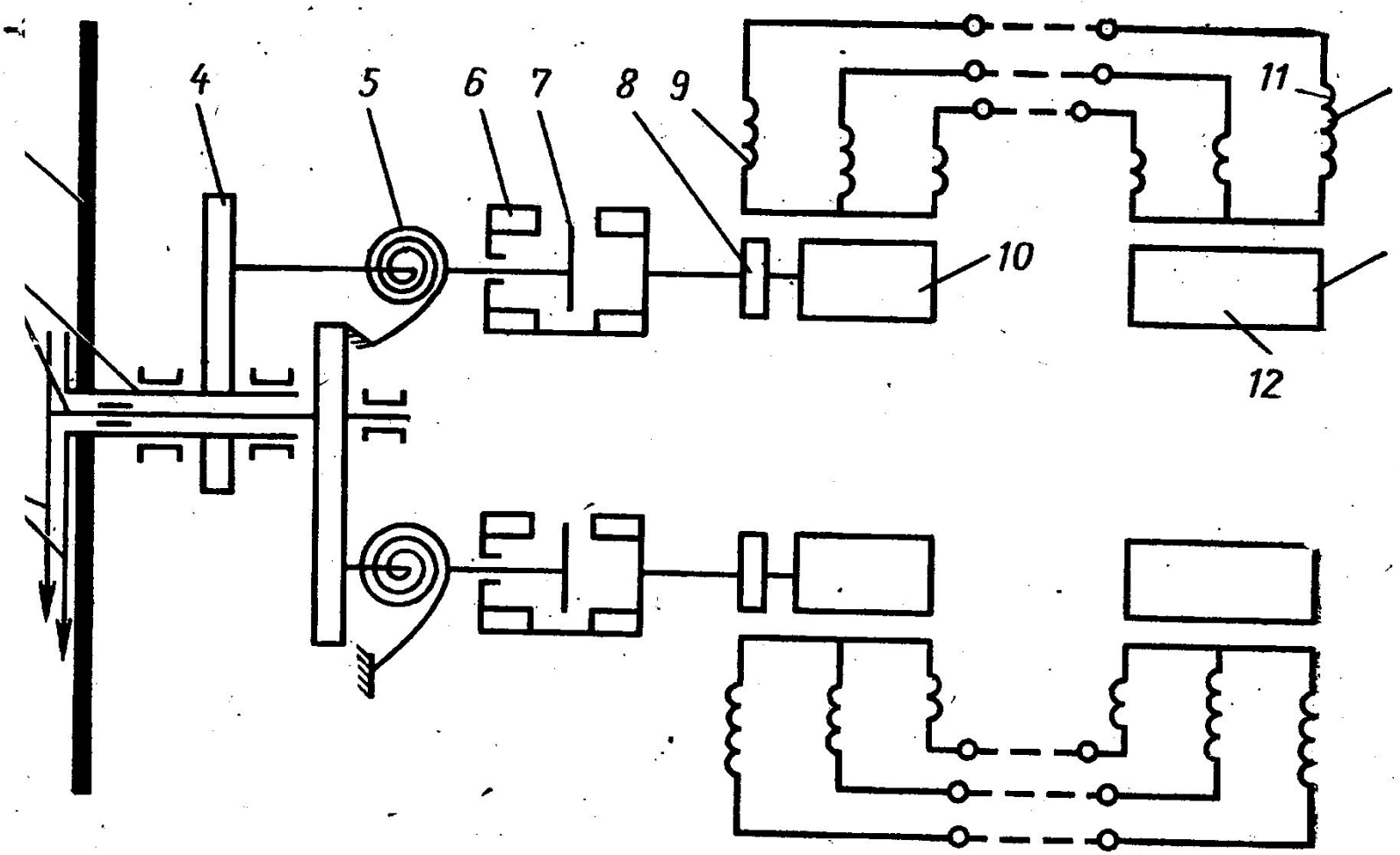
КРД
ENGINE INDICATING

тахометры

DIRECT DRIVEN INDICATION





ис. 100. Принципиальная электрическая схема тахометра ИТЭ-2:

– стрелки; *2* — ось и втулка; *3* — шкала; *4* — зубчатая передача; *5* — отиводействующая пружина; *6* — магнитный узел (муфта); *7* — чувствительный элемент; *8* — гистерезисный диск; *9* — статор указателя; *10* — поянный магнит; *11* — статор датчика *12* — ротор датчика

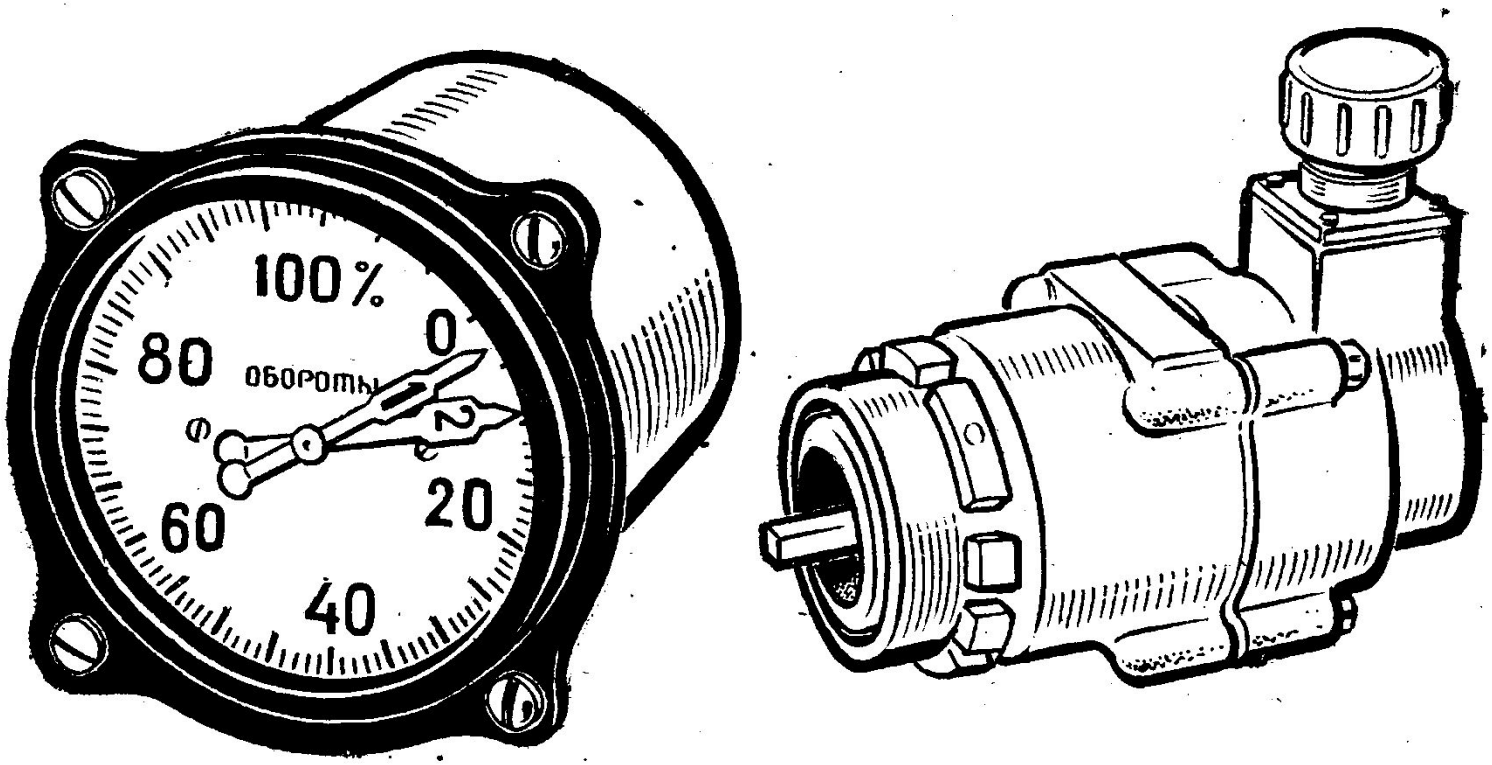
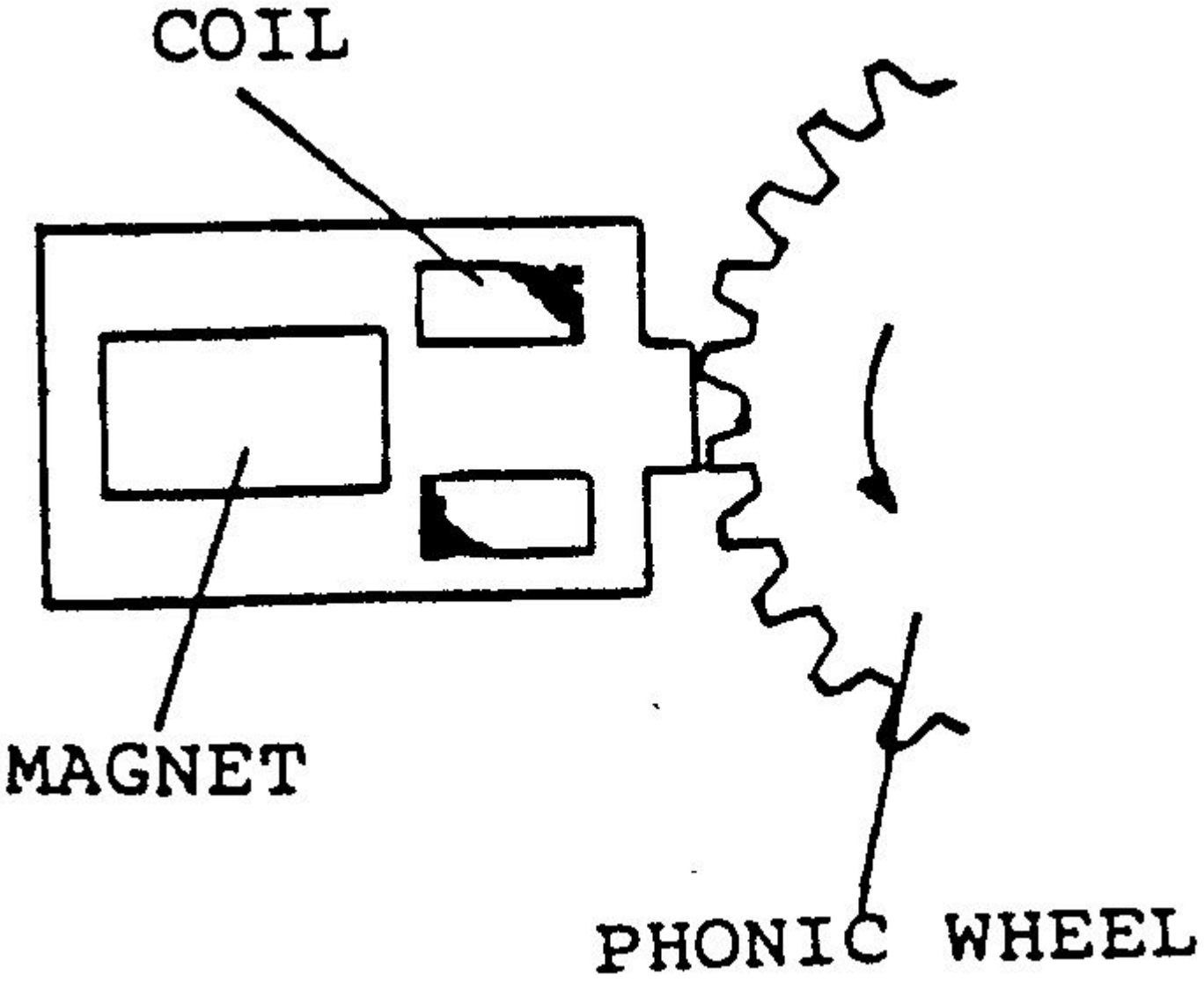
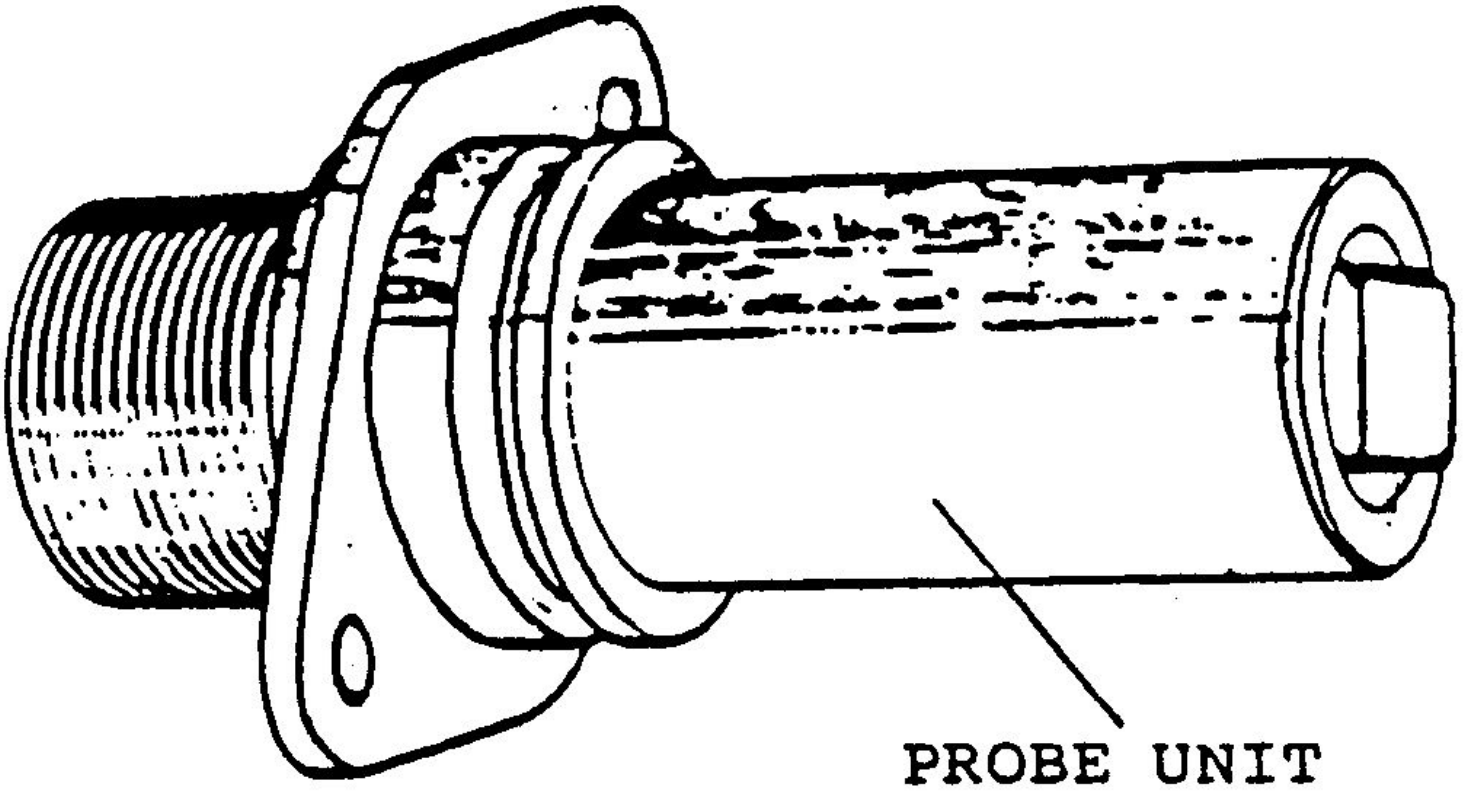
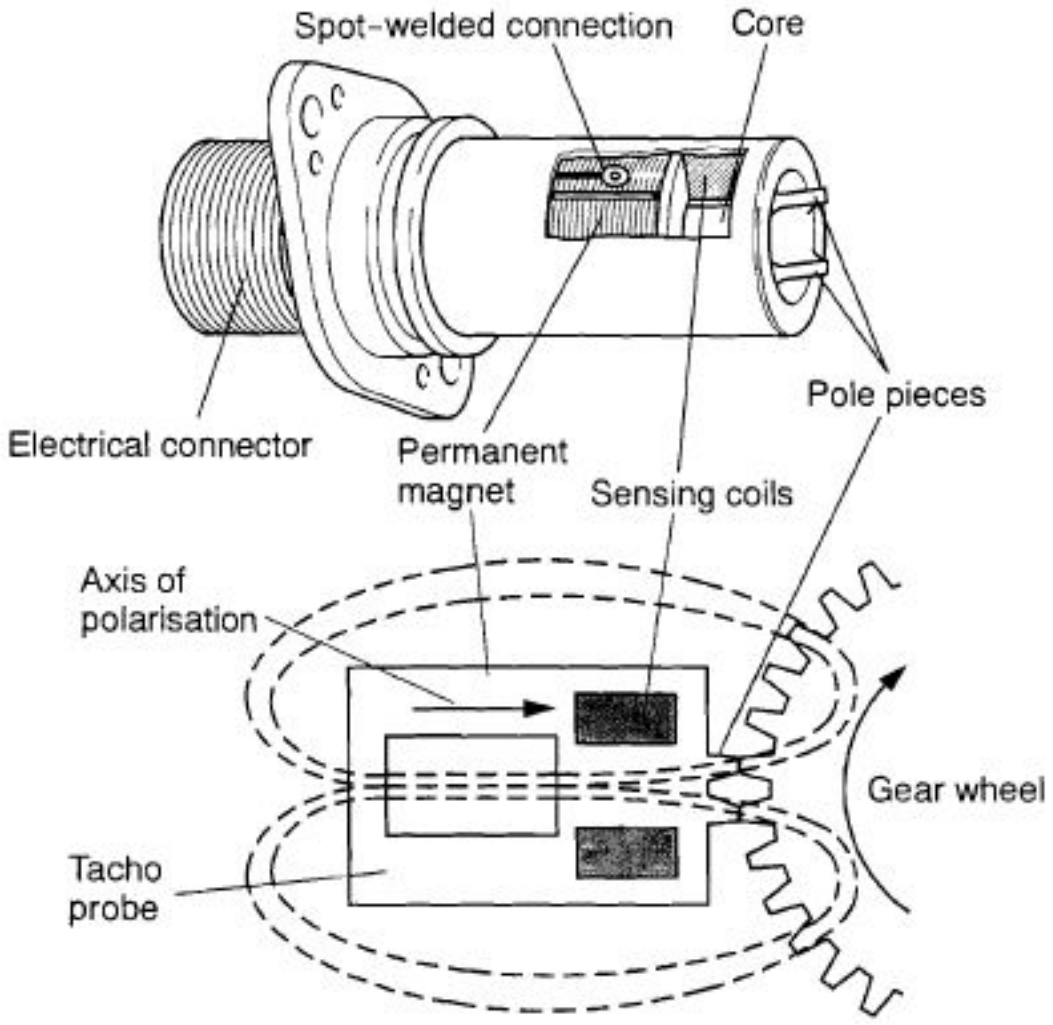


Рис. 99. Тахометр ИТЭ-2


COIL
MAGNET
PHONIC WHEEL


PROBE UNIT


Spot-welded connection
Core
Pole pieces
Electrical connector
Permanent magnet
Sensing coils
Axis of polarisation
Gear wheel
Tacho probe

Speed Measurement System with a Tacho Probe

Refer to **Figure 22.**

A speed measuring system incorporating a tacho probe consists of the following main components:

tacho probe (electromagnetic pick-up) acting as the rpm transmitter

torque synchro inside the rpm indicator

the necessary wiring.

This type of system is used to measure and indicate compressor speeds of an engine. In some turbo fan engines, the speed of the fan can also be measured.

One advantage of a probe is its ability to provide separate electrical output signals to other systems (if required). Another advantage is that a probe has no moving parts.

A tacho probe is made of stainless steel and hermetically sealed (airtight seal) to prevent any foreign matter (dirt, dust) from entering. It consists of a permanent magnet, a pole piece and a number of coils wound around a central ferromagnetic core. A flange on the probe allows it to be mounted at that position inside the engine where the speed measurement is to be made, i.e. where the probe's pole pieces are close to the teeth of a certain gear wheel. This gear wheel is known as a 'phonic wheel'. It is driven at the same speed as the compressor shaft or fan shaft.

The indicator contains a signal-processing module (servo-amplifier), a motor (torque synchro) and a feedback circuit consisting of a potentiometer and a buffer amplifier.
Normally, there are 2 spring-loaded pointers which indicate the rpm. A power supply module provides the necessary AC and DC supplies for the indicator.

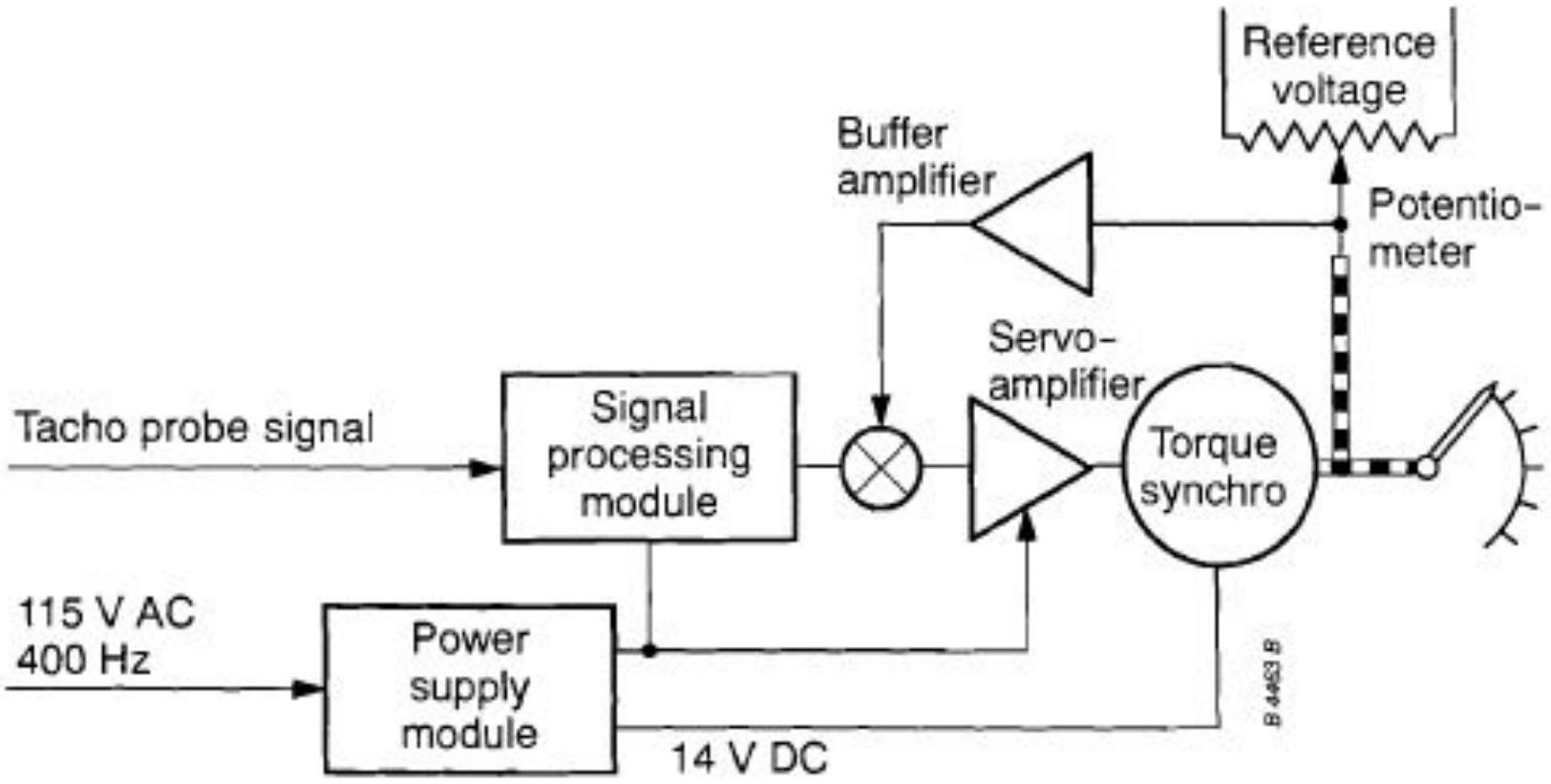
Principle of Operation

Refer to Figure 22 again.
The probe and gear wheel act as a magnetic flux switch that induces electromotive forces into the sensing coils. These forces are directly proportional to the compressor's (or: fan's) speed.
The probe's permanent magnet produces a magnetic field around the sensing coils. As the teeth of the gear wheel pass the pole pieces of the probe, the flux intensity through each pole piece varies, according to the varying width of the air gap between the pole pieces and the gear wheel teeth.
As long as the intensity of the flux changes, an EMF is induced into the sensing coils. Its amplitude depends on the rate of change of flux intensity.
The top of each gear tooth and the bottom of each tooth space are flat. At these points, the intensity of the flux does not change and, as a result, the induced EMF will be zero. However, because the sides of each gear tooth are angled, there is a change in flux intensity as long as the angled sides of the teeth pass the pole pieces.

Principle of Operation

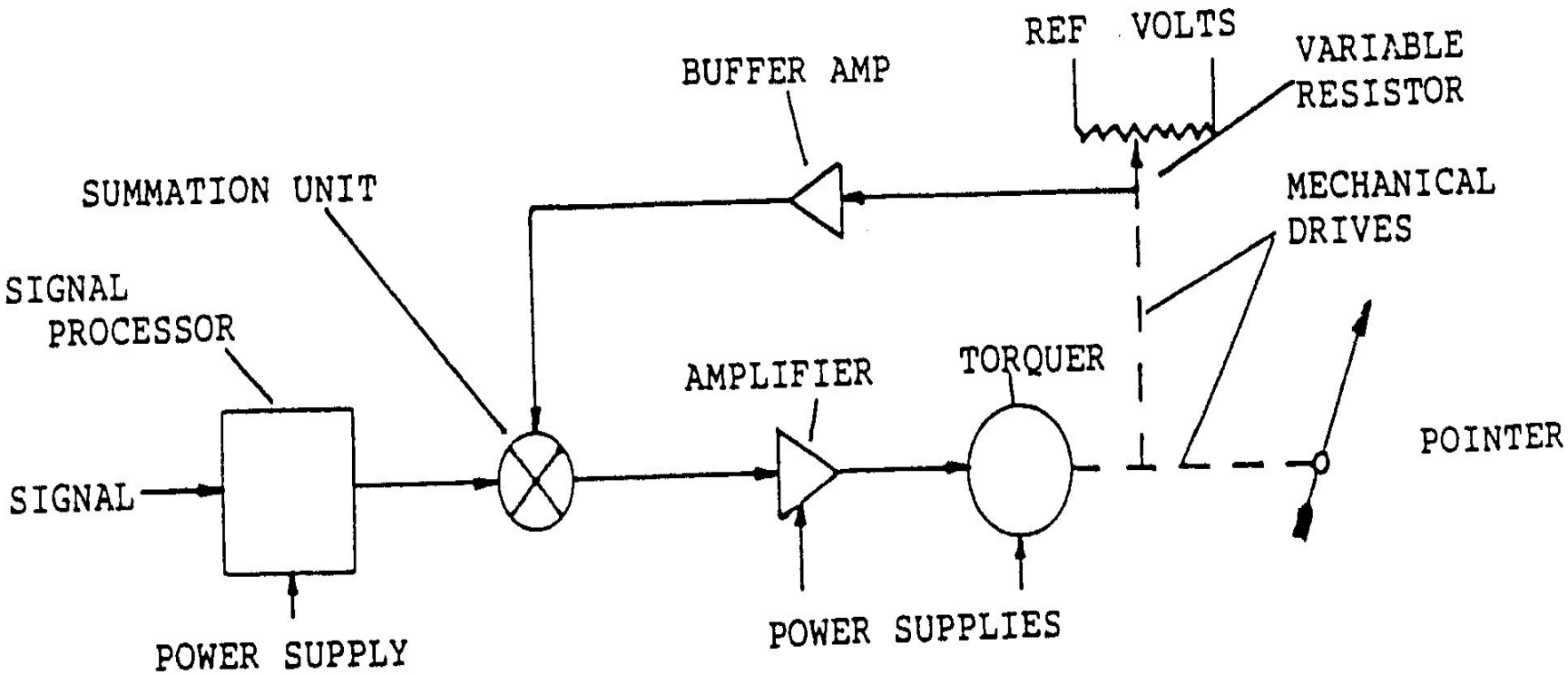
The induced EMF reaches its maximum when the maximum rate of change of flux occurs.
The frequency of the changes of the EMF depends on the number of teeth in the gear wheel (or fan blades).
The signals from the probe, which are to be used for speed indication, are supplied to the indicator's signal processing module. In the module, the signals are added to the outputs of the servo-potentiometer and the buffer amplifier. After summation, the signals are amplified by the servo-amplifier in order to cause the torque synchro to rotate the pointers.
At the same time, the wiper of the servo-potentiometer is moved in order to control the summation of signals to the servo-amplifier.
In the case of a power supply or signal failure the main pointer is returned to an off-scale position by a preloaded spring.
For

Principle of Operation

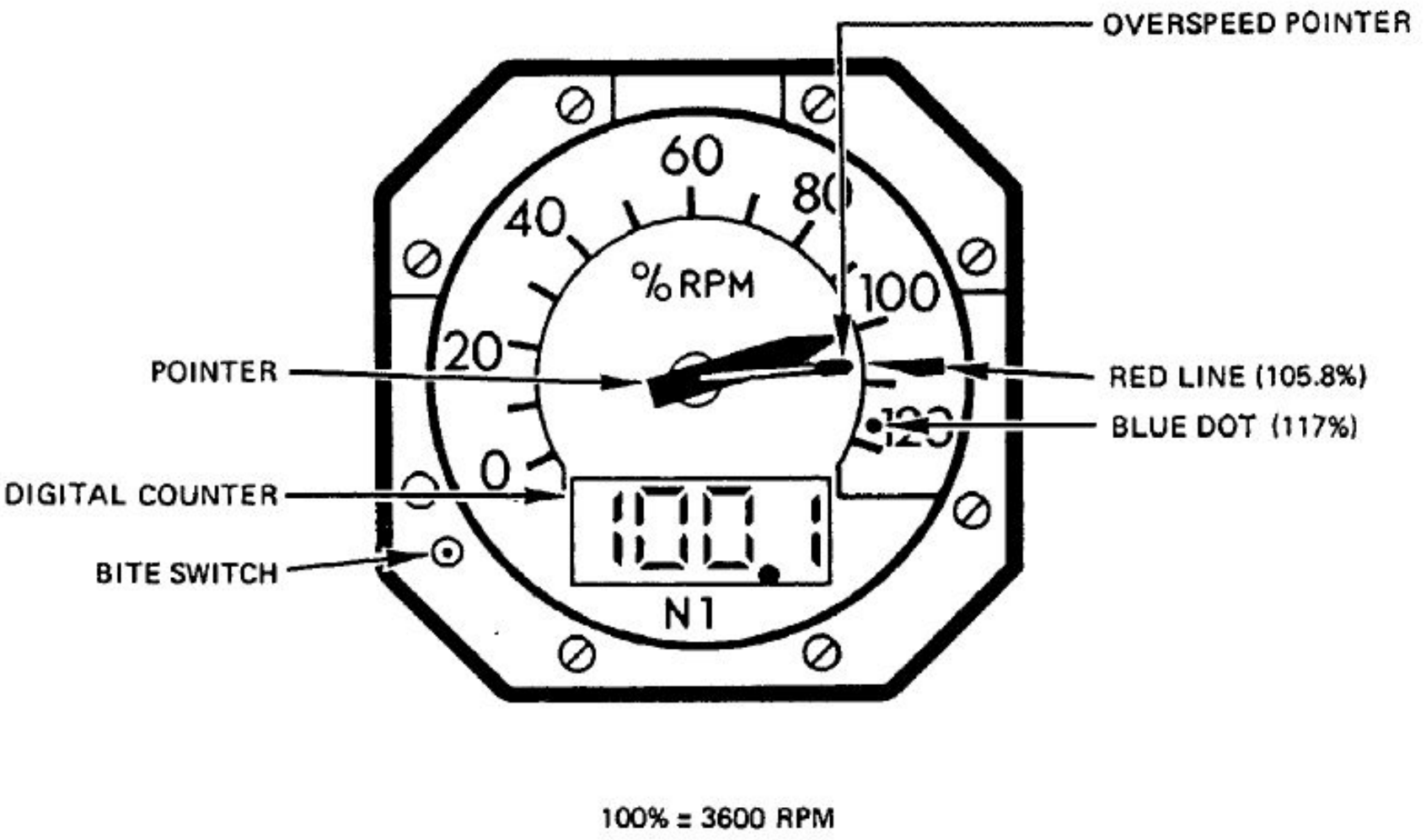


Principle of Operation

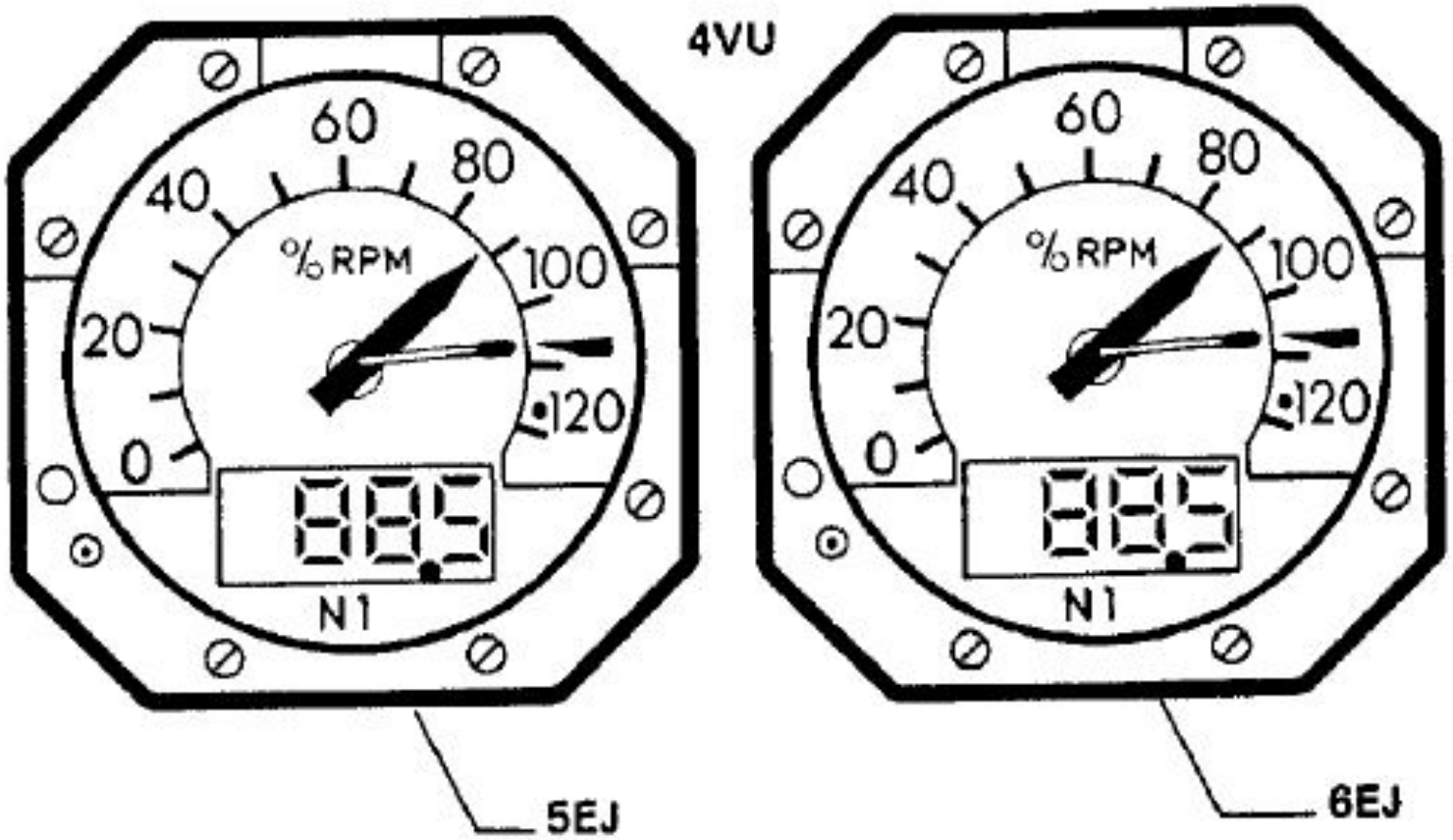
TACHO PROBE SYSTEM INDICATOR



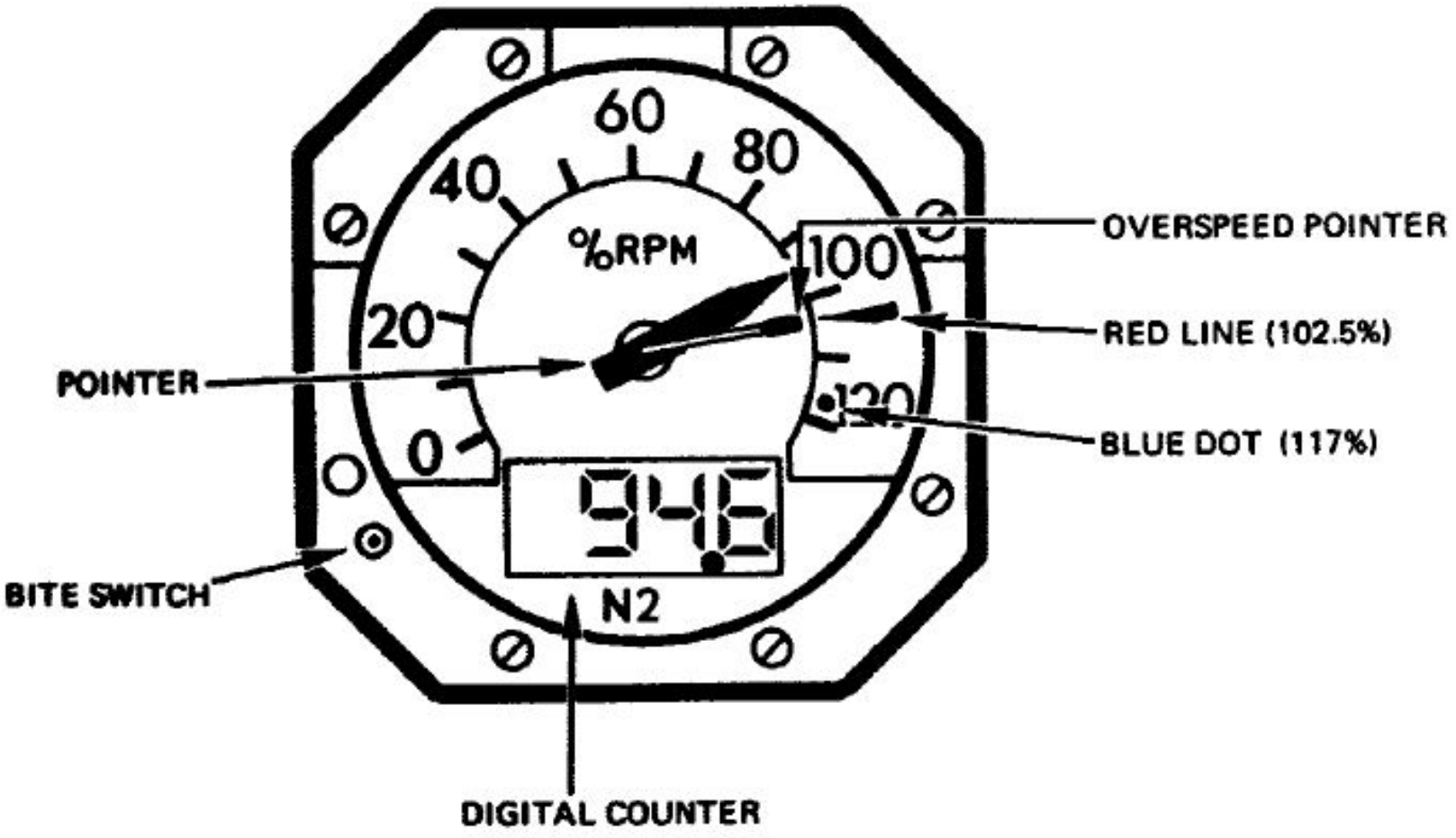
Индикатор N1

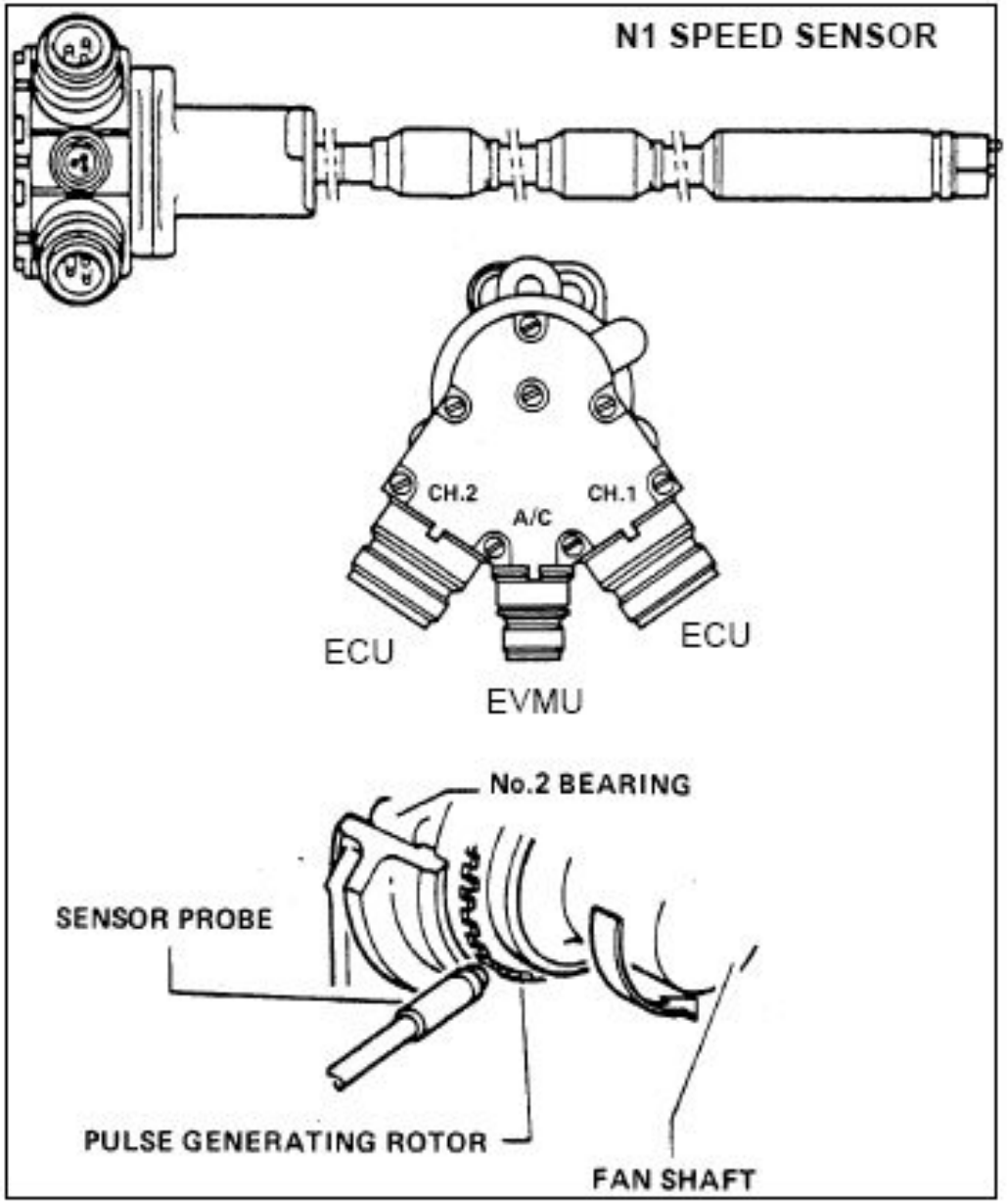


Индикаторы N1



Индикатор N2




N1 SPEED SENSOR
CH.2
A/C
CH.1
ECU
ECU
EVMU
No.2 BEARING
SENSOR PROBE
PULSE GENERATING ROTOR
FAN SHAFT

(A) **ACTUAL N1:** N1 NEEDLE AND N1 DIGITAL INDICATION ARE NORMALLY GREEN. THE NEEDLE PULSES AMBER WHEN THE ACTUAL N1 IS ABOVE THE N1 MAX. BOTH NEEDLE AND DIGITAL INDICATION PULSE RED WHEN THE ACTUAL N1 IS ABOVE THE N1 RED LINE(102%). WHEN N1 IS DEGRADED (BOTH N1 SENSORS FAILED),THE LAST DIGIT OF THE DIGITAL DISPLAY IS AMBER DASHED.

(B) **N1 COMMAND:** N1 CORRESPONDING TO THE ATS DEMAND, LIMITED BY THE THRUST LEVER POSITION. NOT DISPLAYED IF A/THR OFF.

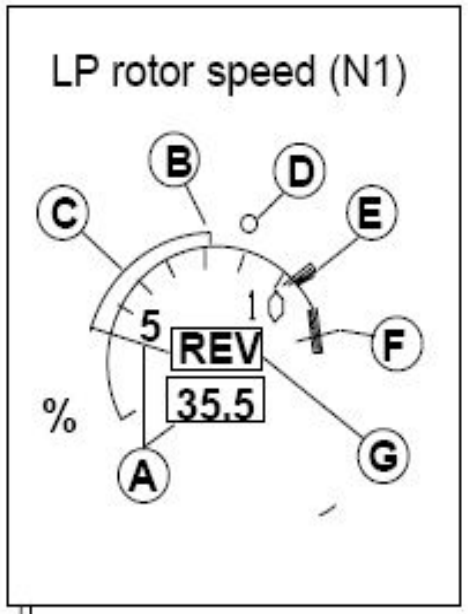
(C) **TRANSIENT N1(BLUE ARC):** SYMBOLIZES THE DIFFERENCE BETWEEN THE N1 COMMAND AND THE ACTUAL N1. NOT DISPLAYED IF A/THR OFF.

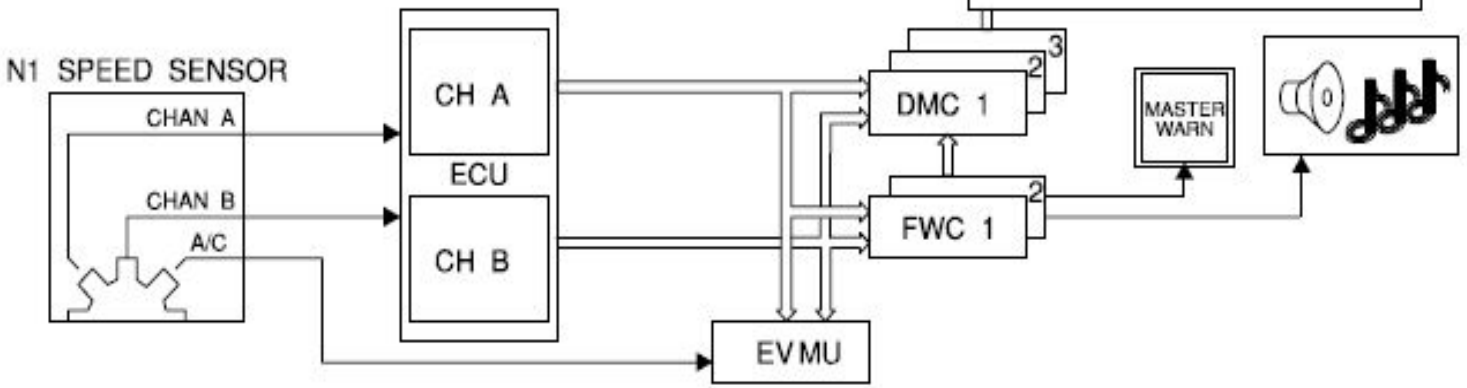
(D) **N1 TLA:** N1 CORRESPONDING TO THE THRUST LEVER POSITION (PREDICTED N1).

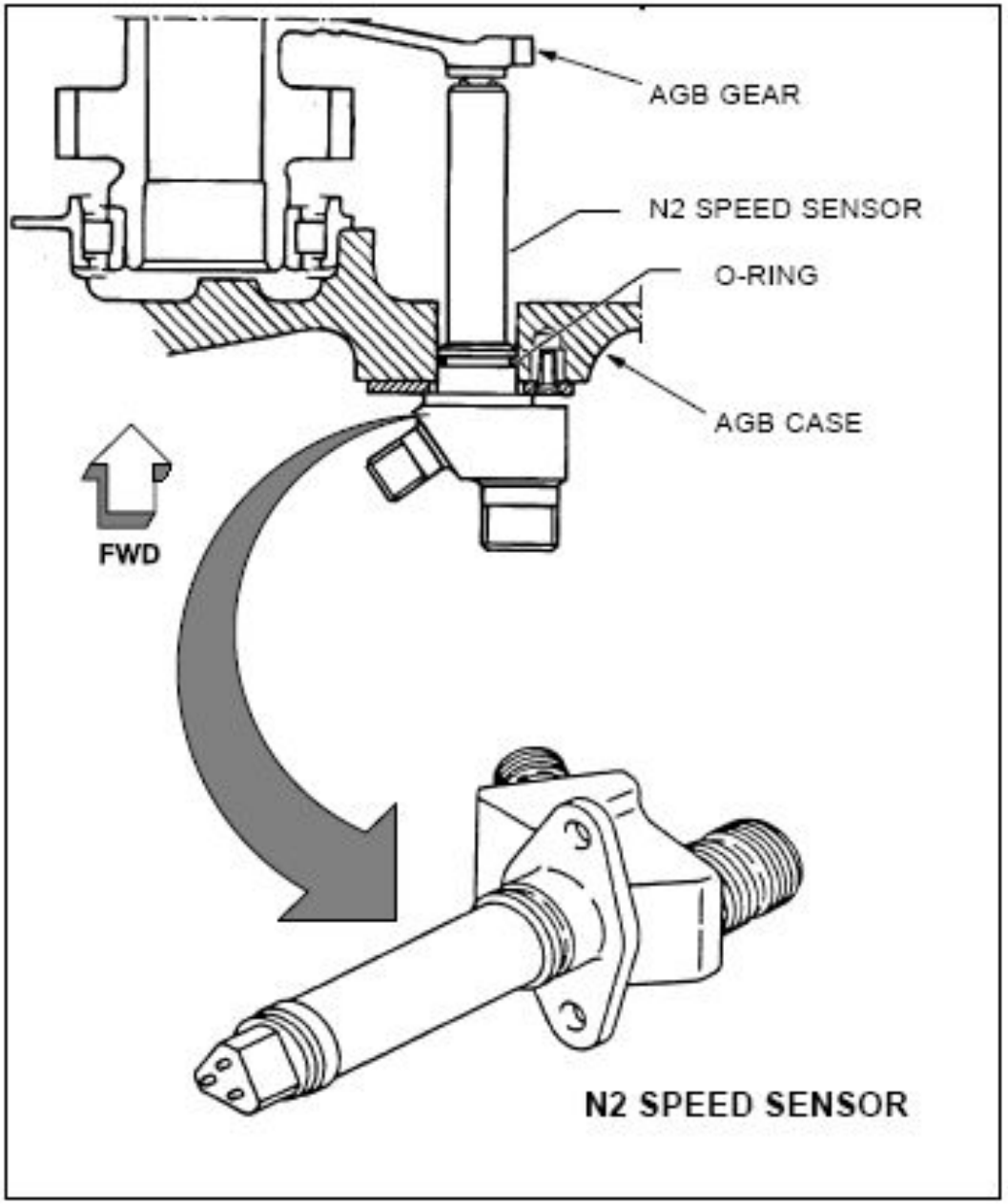
(E) **MAX N1:** AMBER INDEX AT THE VALUE CORRESPONDING TO THE FULL FORWARD POSITION OF THE THRUST LEVER.

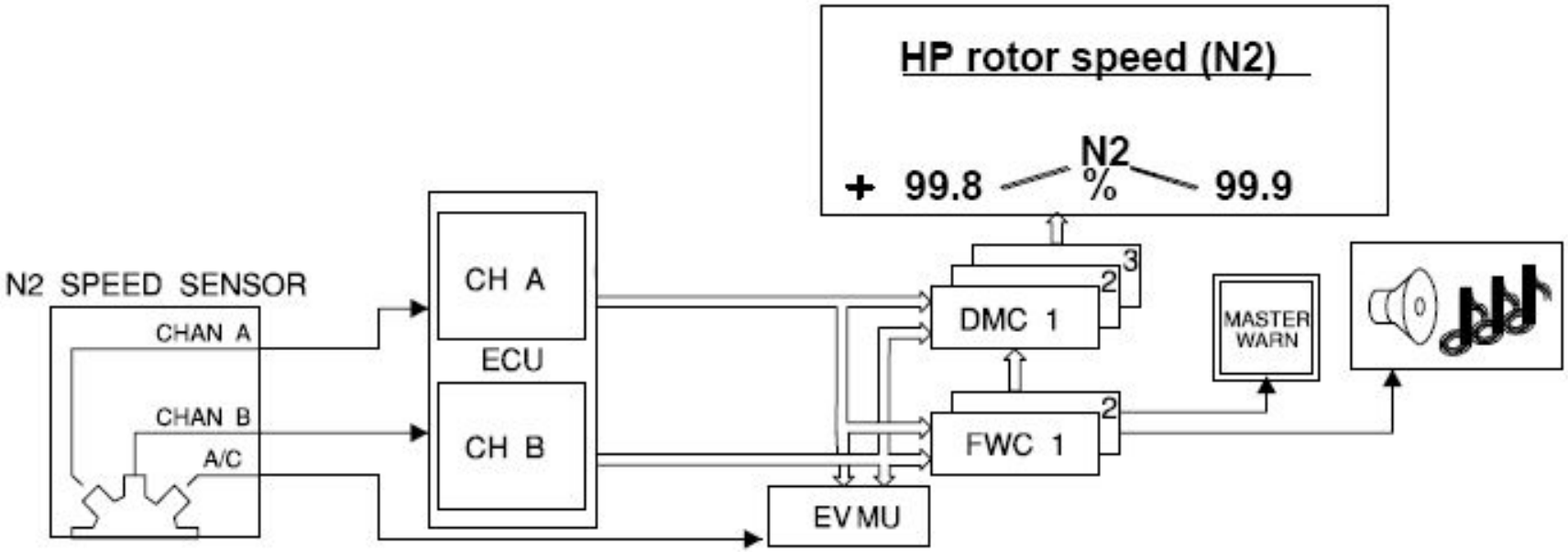
(F) **N1 EXCEEDANCE:** IF 100.3% IS EXCEEDED, A RED MARK APPEARS AT THE MAX VALUE ACHIEVED. IT WILL DISAPPEAR AFTER A NEW START ON GROUND OR AFTER MAINTENANCE ACTION THROUGH THE MCDU.

(G) **REVERSE:** APPEARS AMBER WHEN ONE REVERSER IS UNLOCKED. IT CHANGES TO GREEN WHEN THE DOORS ARE FULLY DEPLOYED. IF UNLOCKED IN FLIGHT,THE INDICATION FLASHES FOR 9 SECONDS AND THEN REMAINS STEADY.






AGB GEAR
N2 SPEED SENSOR
O-RING
AGB CASE
FWD
N2 SPEED SENSOR


HP rotor speed (N2)
+ 99.8
N2
%
99.9
N2 SPEED SENSOR
CHAN A
CHAN B
A/C
CH A
ECU
CH B
DMC 1
3
2
FWC 1
2
MASTER WARN
EV MU