THIRTEENTH EUROPEAN ROTORCRAFT FORUM

Paper N° 5.10
104

WARNING AND SURVEILLANCE SYSTEM (DAV)

GERARD COLLOT

ELECTRONIQUE SERGE DASSAULT

September 8 to 11, 1987
ARLES, FRANCE

ESD N° 12 525 AN July 8, 1987

ASSOCIATION AERONAUTIQUE ET ASTRONAUTIQUE DE FRANCE

1 - GENERAL INFORMATION

Invulnerability of the anti-tank helicopter, until now real because of the helicopter's rapidity of intervention, movement very close to the ground relief and vegetation and the use of weapons of greater range than those of armoured vehicles, is becoming increasingly illusory. Indeed :

- the operation of stand-alone ground-to-air defence systems equipped with missiles of adequate range,

- the accompanying of hostile armoured units by support helicopters,

are changing the parameters of the problem.

From the early 80s, the requirement of air-to-air capability for combat helicopters became apparent. The TRADOC (US Army Training and Doctrine Command) considered at the time that very low-altitude helicopter-against-helicopter combat was a mode of action to be implemented in order to protect ground units.

2 - THREATS

From now onwards, the combat helicopter must be able to face several simultaneous threats :

1) the dangers of tactical flight (proximity of the ground and foliage),
2) hostile ground-to-air defense,
3) friendly ground-to-air defense (indentification friend or foe),
4) hostile combat helicopters,
5) hostile anti-helicopter fighter planes.

The crew of a combat helicopter generally consists of two men. The pilot has his attention fully concentrated on tactical flying and the detection of other threats must be performed by electronic means in order to assist the second crew member. Points 1, 2 and 3 above are not developed in the present paper. Air-to-air threats 4 and 5 only will be examined.

3 - AIR-TO-AIR THREATS

For a combat helicopter flying at very low altitude, air-to-air threats are located in the upper hemisphere centered on the helicopter.

Even assuming that the threats themselves are at low altitude, visual detection through 360° from a safe distance appears to be difficult if not impossible.

It is therefore necessary to assist the crew in detecting, localizing and identifying air-to-air threats represented by combat helicopters and highly manœuvrable airplanes in a sufficiently extensive zone.

It is in order to solve this problem that ESD proposed to the French Military Engineering Directorates the development of a radar Warning and Surveillance System, the DAV.

4 - REQUIRED OPERATIONAL CHARACTERISTICS

The objectives to be achieved by the DAV are :

- to detect at a safe distance, i.e. at a distance of 5 or 6 km, combat helicopters and highly manœuvrable airplanes,
- to provide accurate localization of threats to allow :
  - either evasive action,
  - or the use of weapons such missiles or guns,
- to be usable during all phases of tactical flight,
- not to increase appreciably the radar cross-section or the electromagnetic and infrared signatures of the helicopter,
- to have a very low false-alarm rate,
- to present information in a form enabling the crew to react very quickly,
- to be compatible with optical and optronic sighting systems,
- to have a volume and weight compatible with the size of the helicopter.

5 - ESD EXPERIENCE

The DAV is able to benefit from the experience acquired with equipment already developed by ESD for ground-to-air defence : the RA20S and RODEO 2 radars.

These are Doppler pulse radars operating in the S-band. They can detect airplanes and moving helicopters out to 12 km and helicopters in the hover out to 8 or 10 km, depending on the type of helicopter and its altitude.

The RODEO 2, selected by the French Army for equipping the SANTAL system, allows identification of a tracked helicopter by analyzing the signature the helicopter rotor.

6 - HELICOPTER DETECTION

It is perhaps useful to recall the main characteristics of a helicopter target compared with an airplane target.

The energy reflected by an airplane is fluctuating but continuous. The average radar cross-section varies between 2 and 10 m^2, depending on the type, aspect angle and weaponry carried.

The energy reflected by a helicopter in the hover is cyclic. It is in the form of a series of very brief flashes of high amplitude, the period of which depends on the type of helicopter.

For a given type of helicopter, since the rotor speed is practically constant, identification devices can be implemented. When the helicopter is moving, the echo from its fuselage (approximately 10 m^2) is superimposed on the flashes, the total producing non-negligible energy which explains the considerable ranges obtained even with small radars transmitting relatively low power.

7 - CONSTITUTION OF THE DAV

Since threats are located in the upper hemisphere, it is natural to place the detection means on top of the helicopter. Since possible locations are very limited, an available place is constituted by the main rotor and it is this location which has been selected for installation of the DAV (figure 1).

The DAV consists of the following two subassemblies :

- a faired antenna module rotating with the rotor (figure 2),
- a control and display unit in the cockpit.

The antenna module, which weighs less than 40 kg, comprises the transmitter-receiver and signal processing circuits (figure 3).

The control and display unit comprises only the operating and management controls together with the signature analysis processes. At the present stage of the experimental model, the display is presented on a TV monitor with a B-scope configuration.

7-1 - General Characteristics of the DAV

- Doppler pulse radar,
- S-band,
- flat slotted array antenna,
- solid-state transmitter source and transistors,
- superheterodyne receiver,
- two video encoding channels (0, $\pi/2$),
- Doppler analysis by FFT,
- recognition of airplanes and helicopters,
- identification of helicopter types,
- antenna module weight : 35 to 40 kg
- antenna module dimensions : diameter 750 mm
height 470 mm
- power consumption : < 600 W

7-2 - DAV Performance Characteristics

- Instrumented range : 7 km
- Coverage in elevation : 23°
- Approximate speed of antenna rotation on the helicopter rotor : 5 rps
- Target localization accuracy :
  · in azimuth : < 2°
  · in range : < 100 m

7-3 - DAV Development Programme

Started in 1985, the DAV presently being assembled in the laboratory, should be able to undergo an initial series of trials on a simulated rotor by mid-1988 and a second series installed on a test helicopter by the end of 1988.

At this time, i.e. in approximately 16 months, based on results obtained during the trials, we should be able to build an operational equipment producing with very short reaction time all the information required concerning air threats surrounding a helicopter.

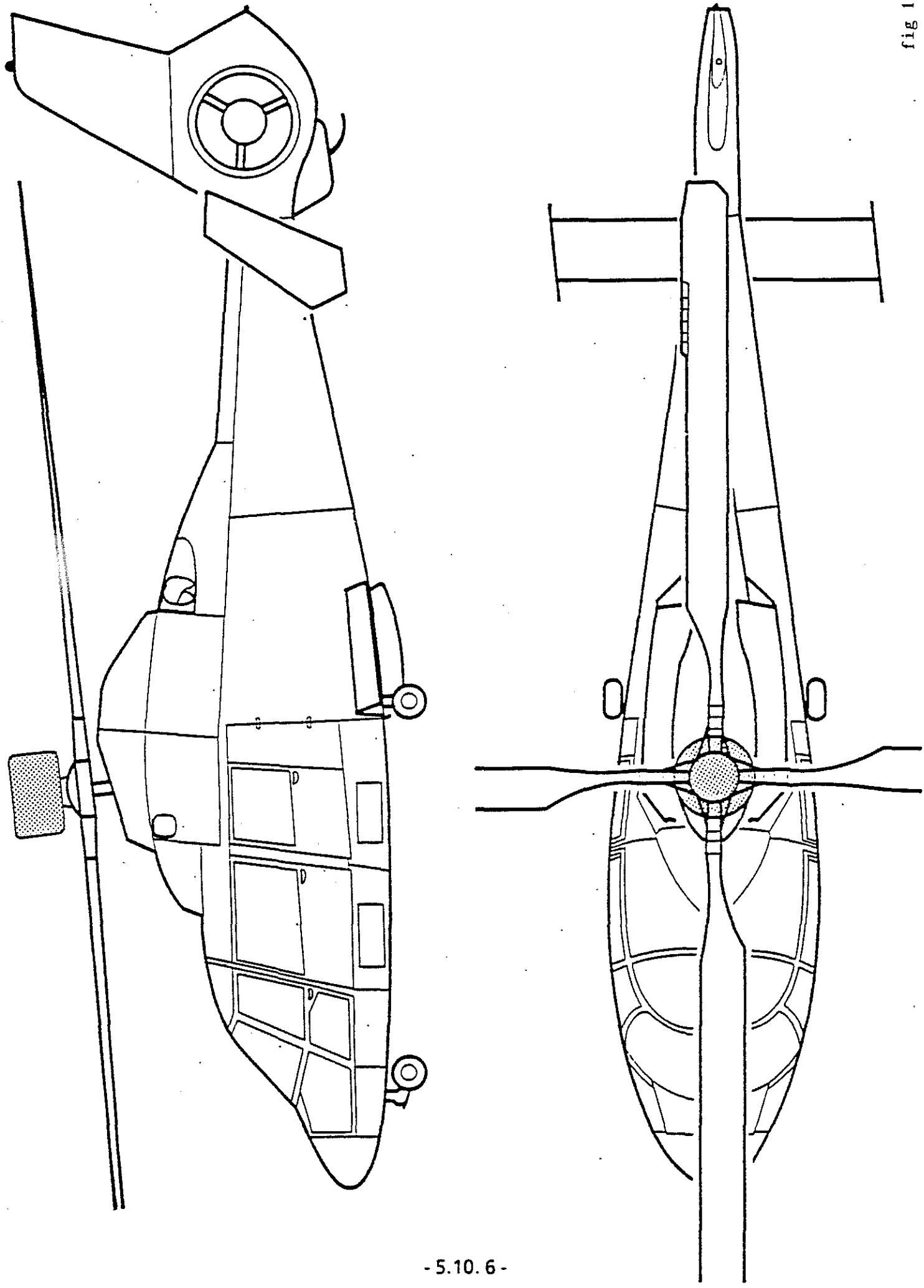
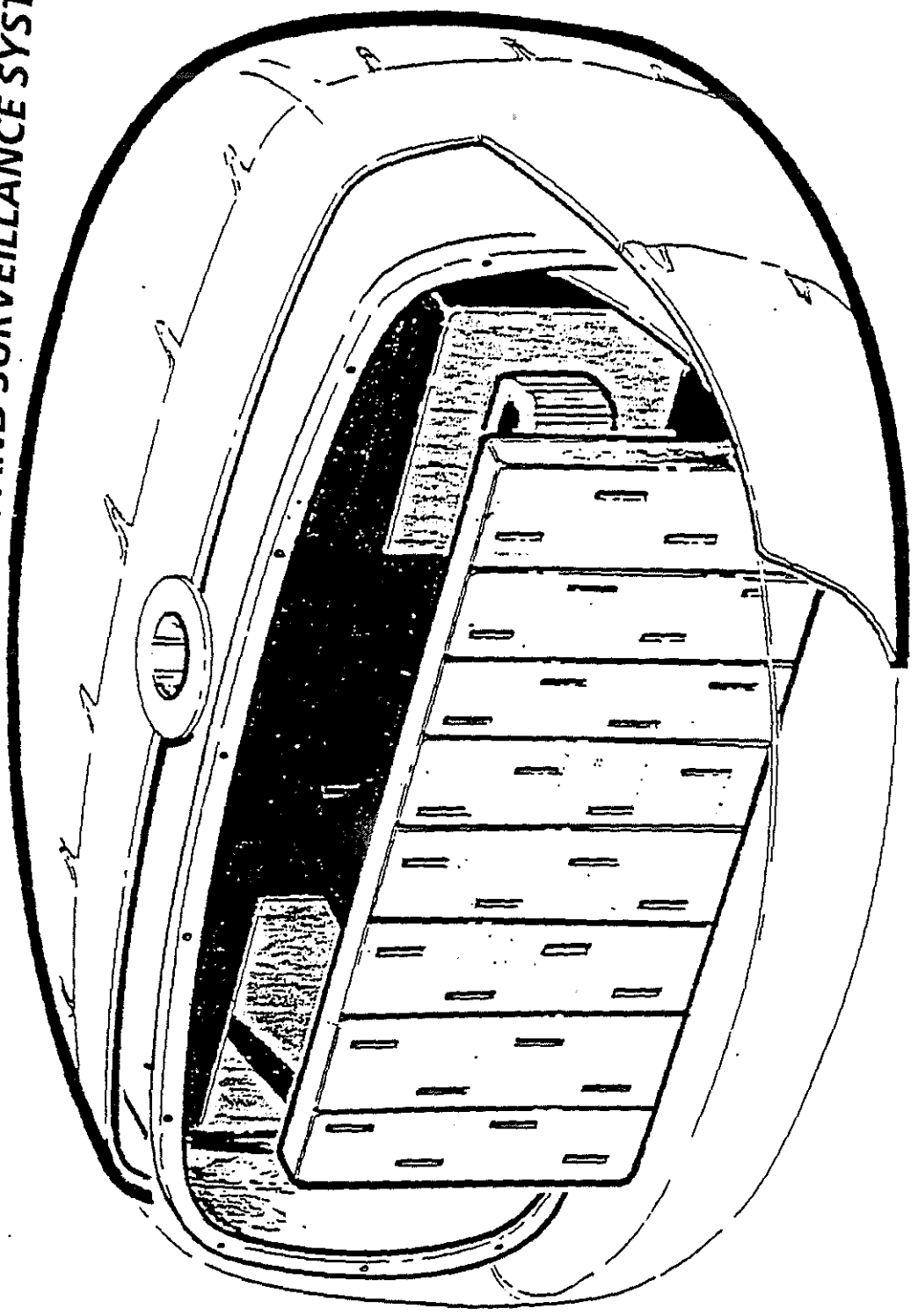


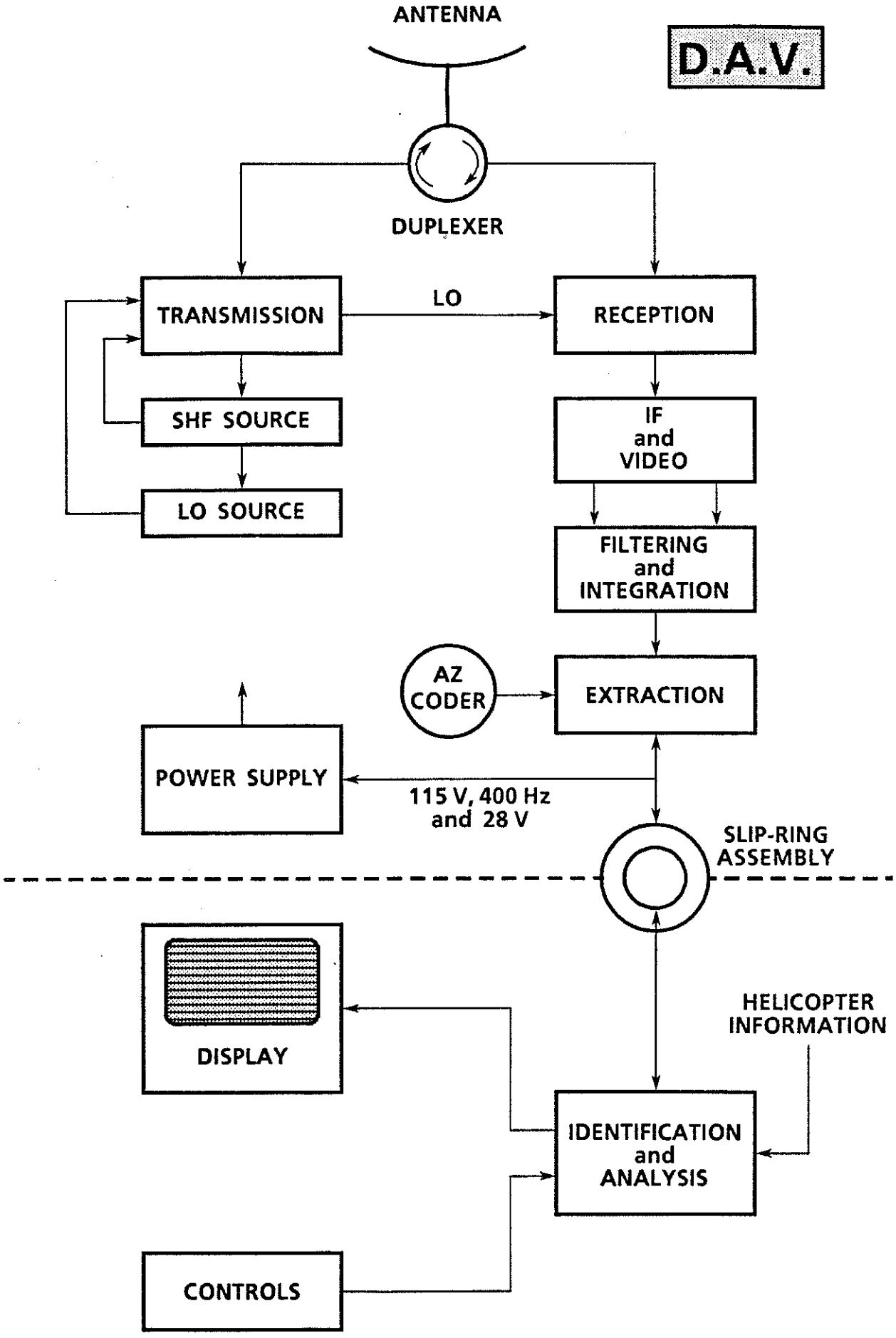
fig 1

fig 2

D.A.V.

WARNING AND SURVEILLANCE SYSTEM




ANTENNA
D.A.V.
DUPLEXER
TRANSMISSION
LO
RECEPTION
SHF SOURCE
IF
and
VIDEO
LO SOURCE
FILTERING
and
INTEGRATION
AZ
CODER
EXTRACTION
POWER SUPPLY
115 V, 400 Hz
and 28 V
SLIP-RING
ASSEMBLY
DISPLAY
HELICOPTER
INFORMATION
IDENTIFICATION
and
ANALYSIS
CONTROLS