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Abstract

ASN reconnaissance RPV system is mini-type, low cost, high flexible multi-mission RPV system which has been used for real time surveillance missions. Reconnaissance missions can be performed day and night through different devices.

The air vehicle performance characteristics, airframe configuration, power plant, system construction, electronic equipment on board and on ground control station are summarized in this paper, film of test flights with video to film excerpts from the TV system will be shown as part of the paper. The main technical specifications of ASN RPV are listed in the paper.

Key Words: Remotely Piloted Vehicle(RPV), Reconnaissance, Vehicle Control

Introduction

ASN Reconnaissance RPV system is mini-type, low cost, high flexible multi-mission RPV which has been used for real time surveillance missions.

Main Technical Specifications

- *Max. level speed (s.l.): 185m/h
- *Cruising speed (2200km-above s.l., medium thrust power): 150km/h
- *Max. operating altitude(above s.l.): 3200m
- *Climbing rate(s.l.): 6m/s
- *Endurance: 2h
- *Max. take-off weight: 140kg
- *Reconnaissance equipment and its service weight: 30kg

- *Taking-off mode: rocket boosted launch
- *Recovery mode: parachute recovery
- *Flight stability
 - (1) Heading rms: 3°
 - (2) Bank rms: 2°
 - (3) Pitch rms: 2°
 - (4) Altitude rms: 40m
- *Max. power of the engine(s.l.): Hs-510 30hp
- *Power of the generators: 125w×2
- *Comprehensive radio system(including remote control, remote measurement, localization, imagery transmission)
 - (1) Acting distance:
 - Main station 100 km
 - Mobile station 60 km
 - (2) Localizational accuracy:
 - Distance rms
 - Main station 50 km
 - Mobile station 100 km
 - Azimuth rms
 - Main station 10 mrad
 - Mobile station 20 mrad
- *Acting distance of the ground retransmission equipment(line-of-sight): 30km
- *Environmental conditions of the use of the air vehicle:
 - (1) Environmental temperature: -40°C—+50°C
 - (2) Environmental humidity: 95+3%(35°C)
 - (3) The air vehicle and the on board equipment should be able bear the impact values of launching, arachuting and landing.
 - (4) Normal wind speed of taking-off and landing: 8m/s
- *Reliability Requirements(tentative):
 - (1) MTBF of the electronic equipment: 30h
 - (2) Regular maintenance period of the air vehicle: 5 taking-off and landings
 - (3) Engine life: 200h
 - (4) Life of the air vehicle body: 50 taking-off and landings
 - (5) Life of the recovery system: 30 taking-off and landings

(6) Rate of success of the recovery system (reliability): >95%

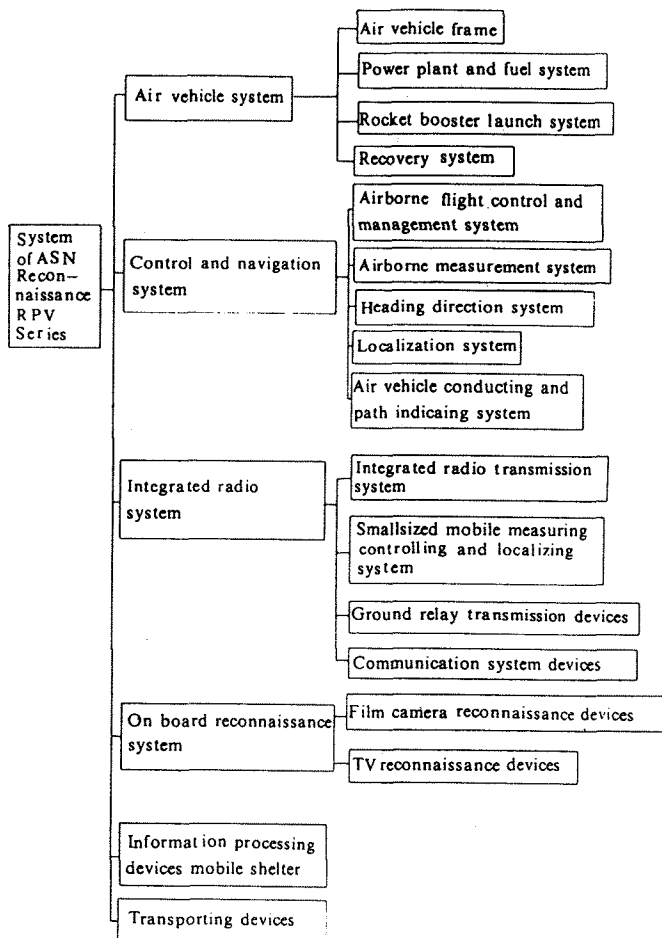
(7) Rate of success of the booster launch (reliability): >98%

*Ground spread and recovery time (at normal temperature): 30min

*Air vehicle maintenance time for a retaking off after normal recovery (at normal temperature): 1h

System Construction

The functional system of ASN lightweight unmanned reconnaissance air vehicle consists of the air vehicle system, control and navigation system, comprehensive radio system, on board reconnaissance system and transporting devices. See figure below



Functional systems of ASN reconnaissance RPVs

Air Vehicle System

The plane adopts the normal open arms upper monoplane model. The wing adopts non backswept and right angle model. The middle wing is straight rectangle with no upper angle. The outer wings are trapeziums with an upper angle of 5°. The tail wings are both trapeziums. The fuselage has a rectangle section with relatively large curved transverse ribs at four corners to reduce the drag. The control surfaces of the plane have ailerons and elevators with an empennage attached to the vertical stabilizer.

The body of the air vehicle is made of honeycomb sandwich structure of glass fiber reinforced plastics. Metal or wooden parts are inserted in the more stressed areas and the larger opening places. In the fuselage there are three compartments of reconnaissance devices for film camera, TV camera, imagery transmitter and its antenna.

The power plant uses the engine HS-510. It is a level symmetric, four cylinder, air cooling and two-stroke piston gasoline engine with a maximum power of 30 hp at sea level, a corresponding rotation speed of 5600 r/min, a short resonant discharge duct and a set-moment two-blade propeller.

The air vehicle takes off through zero length launch with a rocket booster, and recovers with a parachute.

Control and Navigation System

An autopilot is fixed on board to stabilize the attitude and the altitude of the vehicle. The management system on board directly controls and manages the flight attitude. The on board measuring devices carry out the measurements of the data of different flight attitudes and the data of parts of the engine for the ground control and monitor.

"Ranging-goniometry" polar coordinates and passage-calculating methods are used in association to localize the air vehicle according to the combat mission. It gives play not only to the high accuracy of the polar coordinate method but also the better independent and hidden advantages of the passage-calculating method.

There are two modes of controlling the path of the air vehicle: remote control and time

programed control. During the programed control, orders of remote control or a program interruption can be inserted. By remote control the control personnel can perform control through the path indications of the directional system, changing the direction and correction the wind influence if flight deviation from the program is found; thus, the final path deviation less than 2% of the course (more than 50km) is realized.

The time-programed control has 255 change-able program points of time intervals with an arbitrary heading at each point.

The flight command and management system has automatic check-up (and test) functions stationary or at flight, and indicates the faults of the ground equipment.

The comprehensive indication system and the path indication and recording system display the flight state and the flight path comprehensively in the forms of graphs and digits, meters and indicator lights.

The computer of the ground station can record data of the state and the information of the control, and play back the whole process of the flight for later investigation.

Comprehensive Radio System

The comprehensive radio system consists of radio transmission system, smallsized mobile measuring and controlling system and retransmitting devices, with which remote control, remote measurements, localization and imagery transmission are performed.

The "three-in-one" channel system is utilized in the radio transmission system. The ascending and descending channels are no less than six sets; the ascending channel frequency can jump automatically and the descending channel frequency is selected before flight. There are 32 commands of the remote control switch and 8 commands of proportions, 36 channels of remote measuring switch and 22 continuous channels.

The single station "ranging-goniometry" polar coordinate system is utilized in the radio localization system. Its antenna tracks automatically or according to the programed flight course, and it can track manually as well.

Maximum basic band signals of imagery transmission are of 6MHz and 10 MHz. They can be selected manually to fit the requirements of different TV cameras and imagery transmission.

The smallsized mobile measuring and controlling system has complete remote control, remote measurement, ranging and goniometry systems, mainly used to control the flight of the air vehicle, when the main station is blockaded on rugged terrain. It can also be utilized independently and can transmit the descending information and the polar coordinates of the air vehicle to the main station via a relay transmitter, and it can communicate with the main station as well.

The smallsized mobile measuring and controlling system can be mounted on a minibus or carried on a man's shoulders.

On Board Reconnaissance System

A large aperture zooming lens was coupled to a high-resolution TV camera and placed on a light gimbal platform. The zoom capability of the lens allowed the field of view to be varied from 56 degrees to 5.6 degrees. The wide angle provided a broad field of coverage and the zoom feature, along with the pointing accuracy of the gimbal, allowed an object the size of a car to be detected at a range of over 3 kilometers. All video data was shown in realtime and recorded at the ground control station for later review and analysis. The afterward treatment of the reconnaissance can be carried out in two mobile shelters of information treatments of different functions. To supplement the TV and to provide reconnaissance, a 180×180 mm aviation camera was placed in the nose looking straight down through a optical glass window. The camera can record a field of view of 104 degree wide, covering 1700 square kilometers during one flight mission.

An air reconnaissance film camera (f=70mm, image format = 18cm×18cm), and a black and white vacuum V camera tube of low illumination (high sensitivity) are also mounted on board.

There are spare interfaces on board for users to exchange of panoramic camera and line scanning CCD TV camera or IR line-scanner.

Reconnaissance missions can be performed day and night through different devices.

Ground Control Station Construction

- *Main control station mobile shelter: one
- *Mobile control station shelter: one
- *Air vehicle carrier: one
- *Photo development mobile shelter: one
- *TV editing mobile shelter: one

Main Technical Specifications of the Film Camera

- *Focal length of the object lens: $f=110\text{m}$
- *Relative aperture: $F=1:6.3$ 1:8 1:11 1:16
1:22
- *View angle: $2=104^\circ$
- *Image frame: $180\text{mm}\times 180\text{mm}$
- *Film load(190mm film with sprocket holes

- along the two sides): $L=30\text{m}$
- *Number of exposures: $N>150$
- *Resolution ratio(using film of Aviatational Micro-1)
 - in center: $R_c>=50\text{Lp/mm}$
 - on edges: $R_e>=20\text{Lp/mm}$
- *Exposure time of the between-lens shutter:
 $1/50, 1/100, 1/200, 1/300\text{s}$
- *Photographic working range
 - Normal picture-taken height: 100-2000m
 - Picture-taken speed of level flight:
 $150-200\text{km/h}$
- *Longitudinal overlapping ratio: 20% or 60%,
selectable
- *Flattened by negative air pressure provided
by the air vehicle: no less than 1960 Pa
(200mm water column)
- *Max. distortion: 2%
- *Shortest circulation time of the camera: 8s
- *Data record: Number of exposures N is
recorded on the film.