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International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 7 : H04B 7/185, B64D 5/00, B64C 39/02, B64D 39/00	A1	(11) International Publication Number: WO 00/54433 (43) International Publication Date: 14 September 2000 (14.09.00)

(21) International Application Number: PCT/US00/05829

(22) International Filing Date: 6 March 2000 (06.03.00)

(30) Priority Data:
09/264,700 8 March 1999 (08.03.99) US

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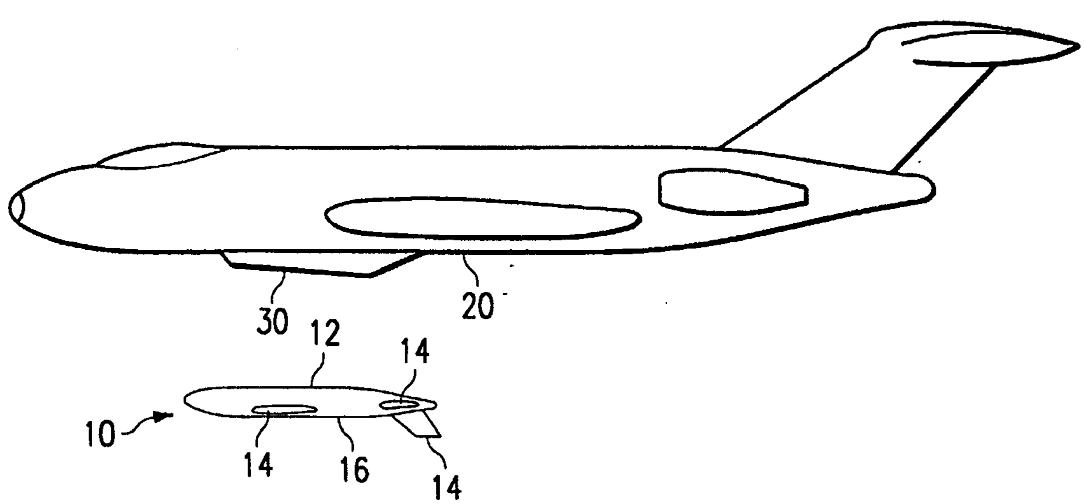
(81) Designated States: CA, JP, European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Published
With international search report.

(54) Title: METHOD AND APPARATUS FOR POSITIONING A LOW COST, LONG DURATION HIGH ALTITUDE INSTRUMENT PLATFORM UTILIZING UNMANNED AIRBORNE VEHICLES



(57) Abstract

A system and method of operating a payload from a high altitude platform. The method involves docking a high–altitude vehicle (10) to a launch vehicle (20). The launch vehicle carries the high–altitude vehicle (10) to an operating altitude where the high–altitude vehicle (10) is released. The payload onboard is placed into operation at the operating altitude. The high–altitude vehicle is replenished as necessary while the high–altitude vehicle (10) is in flight from a replenishment vehicle (20) allowing the high–altitude vehicle to remain in an on–station status. At the completion of the high altitude vehicle flight, the high–altitude vehicle (10) is retrieved from the operating altitude and returned to the surface.

METHOD AND APPARATUS FOR POSITIONING A LOW COST, LONG DURATION HIGH ALTITUDE INSTRUMENT PLATFORM UTILIZING UNMANNED AIRBORNE VEHICLES

TECHNICAL FIELD

The present invention relates generally to a system and method of positioning a high altitude instrument platform, and more particularly, to an system and method of positioning a high altitude instrument platform utilizing unmanned airborne vehicles.

BACKGROUND ART

The use of orbiting satellites as high altitude equipment platforms to maintain communications networks above the earth is costly. This great expense is incurred by the necessity to build these satellites with extremely long life and in placing the satellites in orbit. These costs are only aggravated by the additional and unwanted expense of replacing failed equipment. Furthermore, the time required to build and launch a satellite in orbit can be prohibitive in itself.

The transmissions from the satellites are limited by the available power onboard the satellite and the generally broad antenna patterns. These limitations produce relatively low power signals when received on the ground. Consequently, large, high-gain antennas are needed at ground receiving stations in order to provide adequate signal to noise ratios for wide band signals such as video and the like.

One solution is to employ the use of conventional high-altitude aircraft of various types. This increases the received signal strength. However, this is also an expensive solution, requiring at least two highly specialized aircraft with identical communications suites. This duplication is necessary in order to provide continuity of service while the aircraft are serviced.

Another solution is to operate an unmanned aircraft at high altitudes using solar powered cells mounted on the top of the aircraft. However, such solar powered aircraft become limited by the size and weight of the batteries required in order to operate the aircraft and communications equipment during periods of darkness.

Hence, communication networks often rely on antenna towers located on the ground for most communication purposes. These ground based towers provide only a limited area of coverage due to the line of sight requirement of their transmitted signals and the earth's curvature. Consequently large numbers of such towers are necessary to provide adequate geographic coverage.

Thus, there is a need for a low cost unmanned high altitude equipment platform.

There is a need for an improved system and method of establishing communication networks utilizing high altitude, unmanned equipment platforms.

Moreover, there is a need for an improved system and method of positioning high altitude unmanned equipment platforms which carry high altitude instrument packages which can be used to establish low cost, reliable continuous communication networks.

DISCLOSURE OF INVENTION

The present invention provides a system and method for positioning a low cost, long duration, high altitude instrument platform utilizing airborne vehicles. Specifically the present invention provides a system and method of positioning a high altitude instrument platform utilizing unmanned airborne vehicles.

More specifically, the present invention provides a system and method of operating a payload from a high altitude platform. The method involves docking a high-altitude vehicle to a launch vehicle. The launch vehicle carries the high-altitude vehicle to an operating altitude where the high-altitude vehicle is released. The payload onboard is placed into operation at an operating altitude. The high altitude vehicle is replenished as necessary from a replenishment or support vehicle while the high-altitude vehicle remains in an on-station status. At the completion of the high altitude vehicle flight, the high-altitude vehicle is retrieved from the operating altitude and returned to the surface.

The present invention also provides a low-cost, high-altitude, unmanned aircraft capable of sustained operation at high altitudes for long periods of time. This aircraft can carry communication relay and switching equipment to a high altitude and maintain that equipment in operation on a continuous basis. This allows a continuous and wide area of ground coverage for communications networks.

In one embodiment of the present invention, the unmanned aircraft can be mounted to the underside of a support aircraft. The support aircraft ferries the unmanned aircraft to a desired operating altitude.

This design allows the unmanned aircraft to be optimized for long duration high altitude flight in that the unmanned aircraft need not be burdened with the weight of landing gear and powerful engines necessary for taking off and climbing to an operating altitude. Rather, a support aircraft can release the unmanned aircraft during flight at or near the desired altitude for independent operation of the unmanned aircraft. Further, the support aircraft can dock with the unmanned aircraft during high-altitude flight for the periodic refueling and replenishing the unmanned aircraft without interrupting the operation of the payload. The unmanned, high-altitude aircraft can be repeatedly refueled during operation at high altitude by support aircraft to allow extended flights. Therefore uninterrupted use of high-altitude payloads such as communication equipment carried by the unmanned aircraft can be provided.

Only when ground based maintenance is required need the support aircraft dock with the unmanned aircraft for the purpose of returning the unmanned aircraft to the ground.

The present invention provides an important technical advantage by positioning communications relay equipment at high altitudes for wide area ground coverage at less cost than other methods such as satellites or manned aircraft.

The present invention provides an important technical advantage in providing a practical and affordable means to position and retrieve high-altitude based communications platforms.

The present invention provides an important technical advantage in providing rapidly deployable high altitude communications platforms in the event of failures of existing networks or the need for new networks.

The present invention provides yet another important technical advantage in that the invention provides a practical system to place and hold communications relay equipment at sufficient altitudes to allow desired ground coverage with adequate signal to noise ratios for reception without elaborate high-gain antennas and receivers. These elaborate high-gain antenna are typically necessary in cases where satellite are deployed as communication relay equipment platforms at far greater distances than the present invention.

BRIEF DESCRIPTION OF DRAWINGS

For a more complete understanding of the present invention and the advantages thereof, reference is now made to the following description taken in conjunction with the accompanying drawings in which like reference numerals indicate like features and wherein:

FIGURE 1 shows a side view of a support aircraft on the ground with an unmanned aircraft docked to a docking apparatus located on the underside of the support aircraft;

FIGURE 2 is a side view depicting a support aircraft during flight with an unmanned aircraft docked to a docking apparatus located on the underside of the support aircraft;

FIGURE 3 is a side view depicting a support aircraft during flight with an unmanned aircraft in independent flight below the support aircraft;

FIGURE 4 depicts a sideview of an unmanned aircraft docked to a docking apparatus located on the underside of the support aircraft wherein a cavity of the docking apparatus is illustrated as accepting the upper exterior surfaces of the unmanned aircraft; and

FIGURE 5 illustrates an unmanned aircraft in independent flight operating above a metropolitan area to which the unmanned aircraft relays communication signals.

BEST MODE FOR CARRYING OUT THE INVENTION

Preferred embodiments of the present invention are illustrated in the FIGURES, like numerals being used to refer to like and corresponding parts of the various drawings.

The present invention provides a low-cost, long-endurance, high-altitude unmanned aircraft to maintain various types of payloads such as communication equipment and the like at high operating altitudes over points on the ground on a continuous basis. This allows the communication equipment to provide for uninterrupted services of communications networks.

More specifically, the present invention provides a system and method for operating a payload from a high altitude platform. The method involves docking a high-altitude vehicle to a launch vehicle. The launch vehicle carries the high-altitude vehicle to an operating altitude where the high-altitude vehicle is released. The payload onboard is placed into operation at the operating altitude. The high altitude vehicle is replenished as necessary while the high-altitude vehicle is in flight from a replenishment vehicle allowing the high-altitude vehicle to remain in an on-station status. At the completion of the high altitude vehicle flight, the high-altitude vehicle is retrieved from the operating altitude and returned to the surface.

In operation, one embodiment of the present invention is shown in FIGURE 1 as an unmanned high-altitude aircraft 10 mounted securely to a larger support aircraft 20 by a special docking apparatus 30. FIGURE 1 depicts support aircraft 20 on the ground 40 with unmanned high-altitude aircraft 10 docked to docking apparatus 30. The support aircraft 20 may be either a manned or unmanned aircraft.

The support aircraft 20 takes off from the ground 40 with the unmanned high-altitude aircraft 10 held in place by the special docking apparatus 30 located on the underside of the support aircraft 20.

Referring to FIGURE 2 which illustrates a side view of support aircraft 20 during flight with unmanned high-altitude aircraft 10 docked to docking apparatus 30 located on the underside of the support aircraft. The support aircraft 20 climbs to the desired operating altitude of the unmanned high-altitude aircraft 10 with the unmanned high-altitude aircraft 10 held securely to the support aircraft 20.

Propulsion power for the takeoff and subsequent flight of the combined aircraft is supplied by the engines of support aircraft 20. The control surfaces 14 of the unmanned high-altitude aircraft 10 are positioned to produce near zero lift for the unmanned aircraft 10 during docked flight with the support aircraft 20. This minimizes forces on the lifting surfaces of the unmanned high-altitude aircraft 10 and in turn the stresses placed upon the structure of the unmanned high-altitude aircraft 10 allowing the load bearing requirements of the unmanned high-altitude aircraft 10 to be minimized. Appropriate control signals are supplied from computers located in the support aircraft 20 to direct the control surfaces 14 on the docked unmanned high-altitude aircraft 10.

Once at or near the operating altitude, which may be defined by the payload of the unmanned high-altitude aircraft 10, the unmanned high-altitude aircraft 10 can be released for independent flight as shown in FIGURE 3. FIGURE 3 depicts a side view of a support aircraft 20 during flight with an unmanned high-altitude aircraft 10 in independent flight below the support aircraft 20. To affect this release the docking apparatus 30 of the support aircraft 20 moves the unmanned high-altitude aircraft 10 downward and away from the docking hard points (not shown) of the support aircraft 20. The engine of the unmanned high-altitude aircraft 10 is then started and the unmanned high-altitude aircraft 10 is released from the support aircraft 20 to fly under its own power and control.

Based upon unmanned high-altitude aircraft 10 position and attitude sensors mounted in the support aircraft 20, control computers direct the control system of the unmanned high-altitude aircraft 10 to pull away from the underside of the support aircraft 20 in such a manner as to avoid collision with the support aircraft 20. Upon reaching a safe distance from the support aircraft 20, the control computers aboard the support aircraft 20 release control of the unmanned high-altitude aircraft 10 for independent flight by ground based controllers and on-board control systems of the unmanned high-altitude aircraft 10.

The unmanned high-altitude aircraft 10 will climb slowly from the release or refueling altitude under its own power to the desired operating altitude above any adverse weather effects.

The engine of the unmanned high-altitude aircraft 10, is sized to produce sufficient power for a slow climb of the unmanned high-altitude aircraft 10 from the release and refueling altitudes to the desired operating attitude. The engine or engines are specifically designed and optimized for operation only at high altitudes to enable long endurance between refueling. Additionally, the engine should be operable to climb above any adverse weather effects and maintain the desired operating altitude. Maximum speed of the unmanned high-altitude aircraft 10 must be only that necessary to maintain the unmanned aircraft in the desired location above the ground in the presence of high-altitude winds.

The engine may also be required to produce electrical power to operate payload equipment.

Periodically, it becomes necessary to refuel or replenish the unmanned high-altitude aircraft 10. The unmanned high-altitude aircraft 10 will travel to a refueling altitude to meet support aircraft 20. Communications payloads may continue to perform their functions during such altitude changes and refueling operations as they are located on the underside 16 of the unmanned high-altitude aircraft 10.

The support aircraft 20 approaches the unmanned high-altitude aircraft 10 from behind and at an altitude slightly above the unmanned aircraft as illustrated in FIGURE 3 to minimize stress and turbulence across the unmanned high-altitude aircraft 10. When the support aircraft 20 reaches a point above the unmanned high-altitude aircraft 10 such that the docking apparatus 30 of support aircraft 20 is directly above docking surfaces 12 of unmanned high-altitude aircraft 10, control computers aboard support aircraft 20 take control of unmanned high-altitude aircraft 10. The unmanned high-altitude aircraft 10 is directed to fly into a position directly under the support aircraft docking apparatus 30 within range of docking apparatus 30 so that the support aircraft 20 can capture the unmanned high-altitude aircraft 10.

Upon capture of the unmanned high-altitude aircraft 10 by the docking apparatus 30, the engine of the unmanned high-altitude aircraft 10 is throttled to produce near zero thrust. The control surfaces 14 of the unmanned high-altitude aircraft 10 are controlled by the control computers aboard the support aircraft 20 to minimize aerodynamic lift of the unmanned high-altitude aircraft 10 lifting surfaces. This matches the attitude of the unmanned high-altitude aircraft 10 with that of the support aircraft 20.

If the purpose of the docking operation is to re-supply the unmanned high-altitude aircraft 10 with fuel, engine oil and the like, such fuel and oil transfers are accomplished through the docking apparatus 30 aboard support aircraft 20 while unmanned high-altitude aircraft 10 is docked with the support aircraft 20 as illustrated by FIGURE 2. Upon completion of such transfers, unmanned high-altitude aircraft 10 is again released for independent flight in the previously described manner.

If the purpose of the docking operation is to recapture unmanned high-altitude aircraft 10 for return to the ground, the engine of the unmanned high-altitude aircraft 10 is shut down as opposed to being throttled. Then the support aircraft 20 with the unmanned high-altitude aircraft 10 docked, as illustrated by the drawing in FIGURE 2, returns to and lands on the ground 40. When parked with a suitable ground handling apparatus (not shown) for the unmanned high-altitude aircraft 10 directly below the unmanned high-altitude aircraft 10, the docking apparatus 30 aboard the support aircraft 20 lowers the unmanned high-altitude aircraft 10 to the ground handling apparatus (not shown) and disconnects from the unmanned high-altitude aircraft 10.

The docking apparatus 30 provides a system for a system for releasably docking the aircraft or vehicles together while aerodynamically integrating the high altitude antenna vehicle 10 into the underside of the support aircraft 20. The docking apparatus 30 has lower and side surfaces. The lower and side surfaces have downwardly and laterally inwardly facing exterior surfaces defining a cavity opening onto the bottom and forward portions of the support aircraft 20. The cavity is dimensioned to receive the unmanned high-altitude aircraft 10, with substantially the entire upper surface 18 of the high altitude antenna vehicle enclosed by the exterior surface portions of the cavity as shown in FIGURE 4.

The docking apparatus 30 further contains hardpoints to support and absorb stress experienced by the unmanned high-altitude aircraft 10 during the launch, climb to operating altitude and landing. This stress is borne by the support vehicle 20.

FIGURE 5 illustrates one embodiment of the present invention where an unmanned high-altitude aircraft 10 in independent flight operating on station above a metropolitan area to which the unmanned high-altitude aircraft 10 relays communication signals. This is accomplished by transmitting an electromagnetic signal 52 from a central communications tower 50. The electromagnetic signal 52 is received onboard the unmanned high-altitude aircraft 10. The unmanned high-altitude aircraft 10 in turn retransmits the electromagnetic signal 52 to a cone or footprint defined by the geometry of the antennas onboard the unmanned high-altitude aircraft 10. This cone or footprint is commonly known to those skilled in the art of transmitting electromagnetic signals.

Thus the present invention provides practical means to place and hold communications relay equipment at sufficient altitudes to allow desired ground coverage with adequate signal to noise ratios for reception without elaborate high-gain antennas and receivers as is typically necessary in cases in which satellite deployment of such communication relay equipment at far greater distances is used.

The upper surface 18 of unmanned high-altitude aircraft 10 is equipped with attachment points and mounting hard points. These points enable unmanned high-altitude aircraft 10 to be raised into a docked position against hardpoints on the underside of a support aircraft 20.

In the docked position, the unmanned high-altitude aircraft 10 can be ferried to a high altitude by support aircraft 20. This high altitude is defined by the operating requirements of the payload onboard the unmanned high-altitude aircraft 10. One embodiment of the present invention may utilize an operating altitude of 30,000 to 50,000 feet. This range allows the unmanned aircraft to maintain balance the signal strength of the retransmitted electromagnetic signals 52 and avoid atmospheric disturbances. However, the operating altitude should not be limited to this range. Lower or higher altitudes may be desired depending upon the purpose of the payload on board.

Once released from support aircraft 20 for independent flight, the unmanned high-altitude aircraft 10 is periodically re-captured in flight by a support aircraft 20 for in-flight refueling. This interval again may vary based on operational needs of the unmanned aircraft. However, this periodicity may vary from daily refuelings to preferred larger intervals such as weekly, monthly or quarterly refuelings.

The present invention provides a high altitude platform which in one embodiment may be an aircraft 10 as shown in FIGURE 1. This unmanned high-altitude aircraft 10 may be docked to a docking apparatus 30 located on the underside of the support aircraft 20.

The support aircraft 20 will serves as a launch vehicle to ferry and replenish the unmanned high-altitude aircraft 10 from the ground to an operating altitude.

The support vehicle 20 or launch vehicle is operable to form a continuous load-bearing structure for carrying loads and the releasably docked unmanned high-altitude aircraft 10. Allowing the unmanned high-altitude aircraft 10 to have a low strength structural system designed to sustain high altitude flight only.

Additionally, the unmanned high-altitude aircraft 10 may further contain a parachute system operable to be deployed when an unrecoverable failure has occurred onboard the unmanned high-altitude aircraft 10. This type of failure during independent operation of the unmanned high-altitude aircraft 10 would prevent controlled flight.

In another embodiment of the present invention, the payload of the high altitude can contain a visual imaging device to record visual images of surface conditions which in turn are transmitted to a ground receiving station.

The present invention provides an unmanned, high-altitude, long-duration flight airplane capable of being transported from the ground to a high altitude while docked to special docking apparatus on the underside of a larger, support airplane. The unmanned, high-altitude, long-duration flight airplane is released for independent flight and used for such purposes as carrying payloads consisting of communications receivers, transmitters and antennas to and maintaining these payload at high altitudes for long periods of time. The design of the unmanned airplane is optimized for low-speed, long-duration flight with periodic, but infrequent, in-flight refueling.

The support aircraft 20 can be equipped with position and attitude sensors and on-board control computers and communications. This equipment enables the support aircraft 20 to precisely determine the position and attitude of and control the flight of unmanned high-altitude aircraft 10 upon in-flight separation from the support aircraft 20. The support aircraft can control the approach to the support aircraft 20 for in-flight capture and docking with the support aircraft 20 in order to assure correct and safe positioning of the unmanned high-altitude aircraft 10 with respect to the support aircraft 20.

The present invention also provides the user with a low-cost, high-altitude, unmanned aircraft capable of sustained operation at high altitudes for long periods of time. This aircraft may carry communication relay and switching equipment to a high altitude and maintain that equipment in operation on a continuous basis for the purpose of providing a wide area of ground coverage for communications networks.

In one embodiment of the present invention, the unmanned high-altitude aircraft 10 can be mounted to the underside of a support aircraft 20 that carries the unmanned aircraft to a desired operating altitude. This allows the unmanned high-altitude aircraft 10 to be optimized for long duration high altitude flight in that the unmanned aircraft need not be burdened with the weight or cost of landing gear and powerful engines necessary for the take off and climb to an operating altitude. Rather, a support aircraft can release the unmanned aircraft during flight at the desired altitude for independent operation of the unmanned aircraft. Further, the support aircraft can dock with the unmanned aircraft during high-altitude flight for the purposes of refueling and replenishing the unmanned aircraft without interruption of communications activities. The unmanned, high-altitude aircraft can be repeatedly refueled during operation at high altitude by support aircraft to allow extended periods of interrupted use of the communication equipment carried as payload by the unmanned aircraft.

Only when maintenance is required need the support aircraft dock with the unmanned aircraft for the purpose of returning the unmanned aircraft to the ground.

The present invention provides an important technical advantage in positioning communications relay equipment at high altitudes for wide area ground coverage at less cost than other methods such as satellites or manned aircraft.

The present invention provides an important technical advantage in providing a practical and affordable means to retrieve high-altitude based communications relay equipment and return it to ground bases for repair.

The present invention provides an important technical advantage in providing rapidly deployable replacement equipment to high altitude stations in the event of failures of existing networks.

The present invention provides yet another important technical advantage in that the invention provides practical means to place and hold communications relay equipment at sufficient altitudes to allow desired ground coverage with adequate signal to noise ratios for reception without elaborate high-gain antennas and receivers as is typically necessary in cases in which satellite deployment of such communication relay equipment at far greater distances is used.

Although the present invention has been described in detail, it should be understood that various changes, substitutions and alterations can be made thereto without departing from the spirit and scope of the invention as described by the appended claims.

WE CLAIM:

1. A high altitude platform comprising:

a first stage wherein the first stage is a launch vehicle wherein the launch vehicle is an aircraft comprising:

a docking system for releasably docking the vehicles together, wherein the docking system has lower and side surfaces, wherein the lower and side surfaces have downwardly and laterally inwardly facing exterior surfaces defining a cavity opening onto bottom and forward portions of the aircraft, and wherein the cavity is dimensioned to receive the high altitude vehicle, with substantially the entire upper surface of the high altitude antenna vehicle enclosed by the exterior surface portions of the cavity and integrated into the launch vehicle prior to takeoff, and for releasing the vehicles from each other during flight to allow each vehicle to continue independently on a separate flight path; and

a second stage comprises an unmanned high altitude vehicle carrying a high altitude payload, and wherein the high altitude vehicle is optimized for long-duration, high-altitude operation.

2. The high altitude platform of Claim 1, wherein the launch vehicle further comprises a continuous load-bearing structure for carrying loads and the releasably docked high altitude vehicle.

3. The high altitude platform of Claim 1, wherein the high altitude vehicle has a low strength structural system and a high altitude engine both designed to sustain high altitude flight only.

4. The high altitude platform of Claim 2, in which the docking system comprises hardpoints to support and absorb stress experienced by the high altitude vehicle during launch, climb to operating altitude and landing.

5. The high altitude platform of Claim 4 wherein the high altitude vehicle, further comprising a parachute system to deploy when an unrecoverable failure has occurred onboard the high altitude platform during operation of the high altitude vehicle along its separate flight path.

6. The high altitude vehicle of Claim 5, wherein the payload comprises communication equipment further comprising:

at least one receiver which receives electromagnetic signals; and

at least one transmitter which is coupled to at least one antenna to relay the electromagnetic signals to a geographic footprint associated with the antenna.

7. The high altitude vehicle of Claim 5, wherein the payload further comprises a plurality of sensor to monitor weather conditions wherein a processor located on board the high altitude vehicle will determine a location of an adverse weather condition and direct the high altitude vehicles to alter the flight path of the high altitude vehicle to avoid the adverse weather condition.

8. The high altitude vehicle of Claim 5, wherein the payload further comprises:
at least one visual imaging device to record visual images of surface conditions; and
at least one transmitter coupled to at least one antenna to relay the visual images to a receiving station.

9. A high altitude platform comprising:
a high-altitude vehicle capable of long-duration flight which is transported from a surface location to an operating altitude while docked to a launch vehicle;
a docking system on a bottom surface of the launch vehicle; and
a payload located onboard the high-altitude vehicle comprising receivers, transmitters and antennas.

10. The high altitude platform of Claim 9, where in the high-altitude vehicle further comprises an engine optimized for long-duration, low-speed flight.

11. The high altitude platform of Claim 10, further comprising:
a control system which employs sensors to detect atmospheric disturbance and alter the flight path of the high altitude vehicle to avoid these atmospheric disturbances.

12. The high altitude platform of Claim 11, wherein the flight path of the high altitude vehicle comprises a vertical profile and a horizontal profile, and where in the vertical profile comprises of an altitude greeter than 30,000 feet and the horizontal profile comprises a predetermined horizontal path.

13. The high altitude platform of Claim 12, further comprising a parachute system to deploy when an unrecoverable failure has occurred onboard the high altitude platform which prevents maintained flight.

14. A method for operating a payload from a high altitude platform comprising:
docking a high-altitude vehicle to a launch vehicle;
carrying the high-altitude vehicle to an operating altitude with the launch vehicle;
releasing the high-altitude vehicle at the operating altitude;
operating the payload onboard the high-altitude vehicle at the operating altitude while the high-altitude vehicle remains in an on-station status;
replenishing the high-altitude vehicle as necessary while the high-altitude vehicle is in flight, and wherein the high-altitude vehicle is replenished from a replenishment vehicle while the high-altitude vehicle remains in an on-station status; and
retrieving the high-altitude vehicle from an operating altitude.

15. The method of Claim 14, wherein the high altitude vehicle is an unmanned aircraft.

16. The method of Claim 15, wherein the step of replenishing the high-altitude vehicle further comprises the steps of:

approaching the high-altitude vehicle with a replenishment vehicle at an operating altitude of the high-altitude vehicle;

docking the replenishment vehicle to the high-altitude vehicle, wherein the replenishment vehicle controls the docking of the high-altitude vehicle to the replenishment vehicle;

replacing consumables onboard the high-altitude vehicle wherein consumables comprising fuel and lubricants; and

releasing the high-altitude vehicle at the operating altitude to allow each vehicle to continue independently on a separate flight path.

17. The method of Claim 16, wherein the step of operating the payload onboard the high-altitude vehicle further comprises:

receiving electromagnetic signals with at least one receiver located onboard the high-altitude vehicle.

18. The method of Claim 17, wherein the on station status comprises maintaining a flight path with a vertical profile and a horizontal profile, and where in the vertical profile comprises of an altitude greater than 30,000 feet and the horizontal profile comprises a predetermined flight path.

19. The method of Claim 18, further comprising the steps of:

sensing atmospheric disturbance; and

altering the flight path of the high-altitude vehicle to avoid the atmospheric disturbance while maintaining the payload in an operational status.

20. The method of Claim 19, further comprising the steps of:

transmitting a control signal from a ground control station which directs the high altitude vehicle;

receiving the control signal onboard the high altitude vehicle; and

altering the flight path of the high-altitude vehicle based on directions contained in the control signal.

21. The method of Claim 20, further comprising the steps of:

deploying a parachute from the high-altitude vehicle when an unrecoverable failure occurs onboard the high-altitude vehicle.

22. A method of relaying electromagnetic signals comprising:

transmitting the electromagnetic signals from a first transmitter;

receiving the electromagnetic signals onboard a high-altitude vehicle; and retransmitting the electromagnetic signals from a transmitter and antenna located onboard the high-altitude vehicle to an antenna footprint associated with the flight path of the high-altitude vehicle.

23. The method of Claim 22, further comprising:

determining a targeted location for the electromagnetic signal from a location address contained in the electromagnetic signal;

establishing a network connection with the high-altitude vehicle and at least one secondary high-altitude vehicle; and

routing the electromagnetic signal to the secondary high-altitude vehicle wherein an antenna footprint associated with a flight path of the secondary high-altitude vehicle contains the targeted location.

24. A system for relaying electromagnetic signals comprising:

a first transmitter which transmits the electromagnetic signals;

a receiver onboard a high-altitude vehicle to receive the electromagnetic signals; and

a second transmitter coupled to an antenna for retransmitting the electromagnetic signals from the transmitter and antenna located onboard the high-altitude vehicle to an antenna footprint determined by the flight path of the high-altitude vehicle.

25. The system of Claim 24, further comprising:

a location address determining a targeted location for the electromagnetic signal in the electromagnetic signal;

a network connection between the high-altitude vehicle and at least one secondary high-altitude vehicle; and

routing the electromagnetic signal received to onboard the high-altitude vehicle to the secondary high-altitude vehicle via a network connection established between a plurality of high-altitude vehicles wherein a transmission footprint associated with a flight path of the secondary high-altitude vehicle contains the targeted location defined by the location address.

FIG. 1

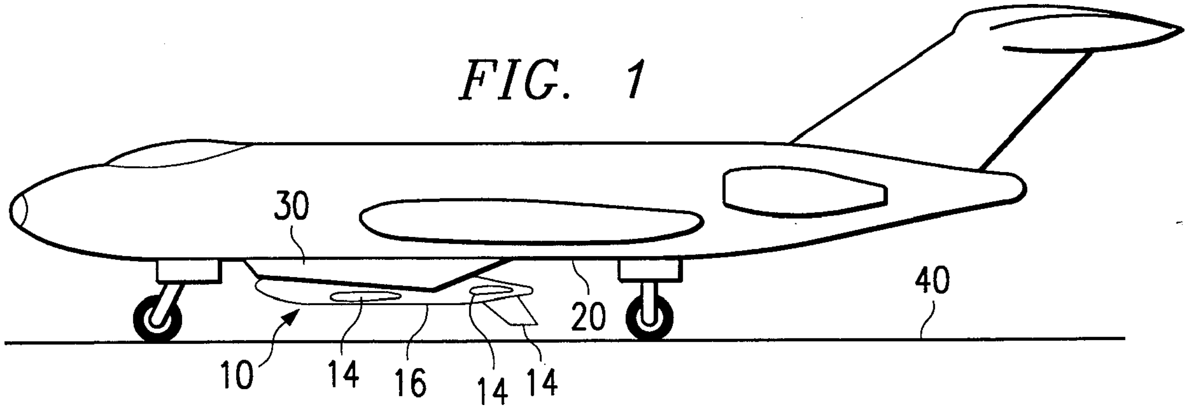


FIG. 2

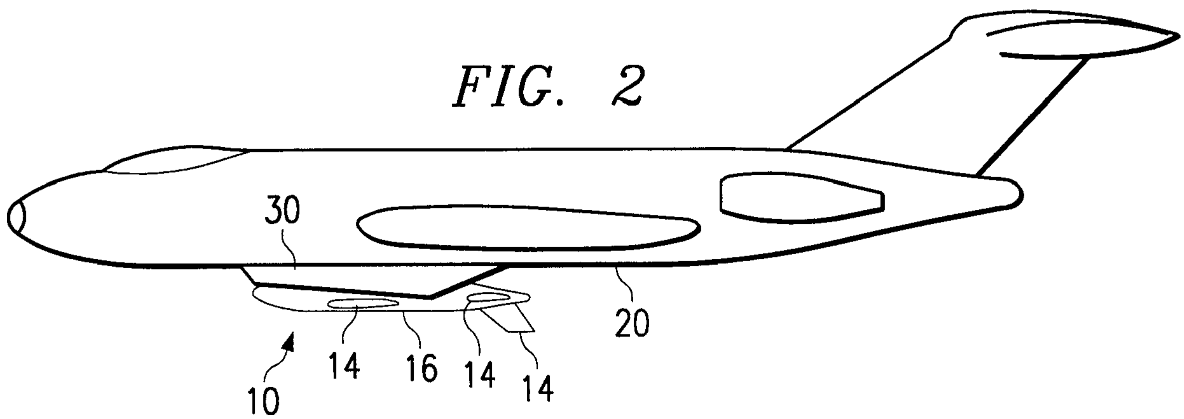
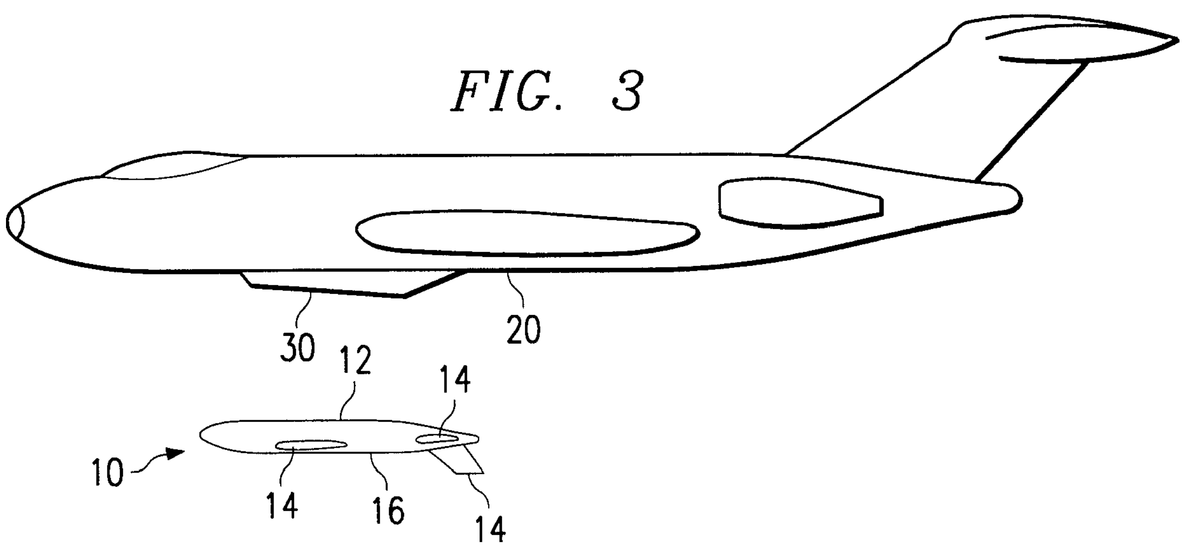


FIG. 3



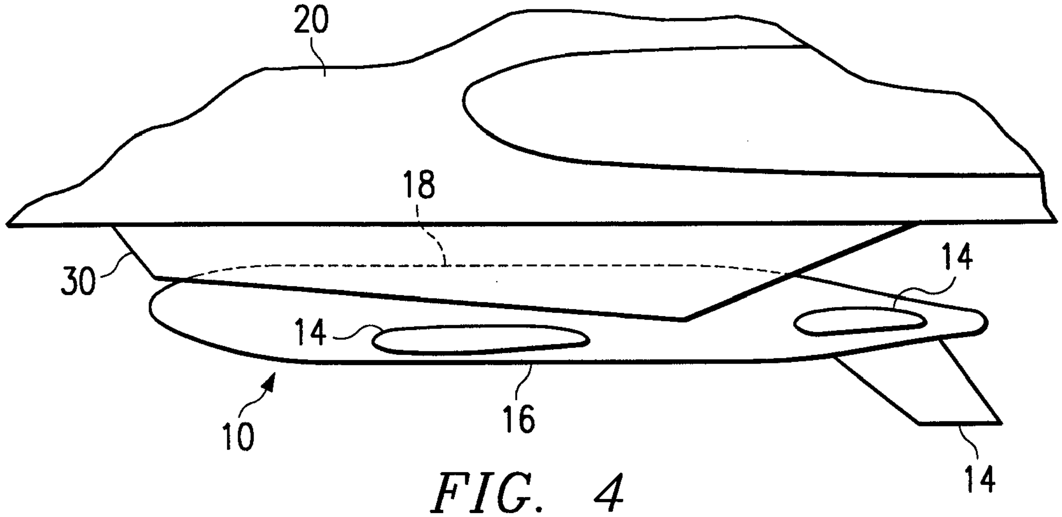

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FIG. 4

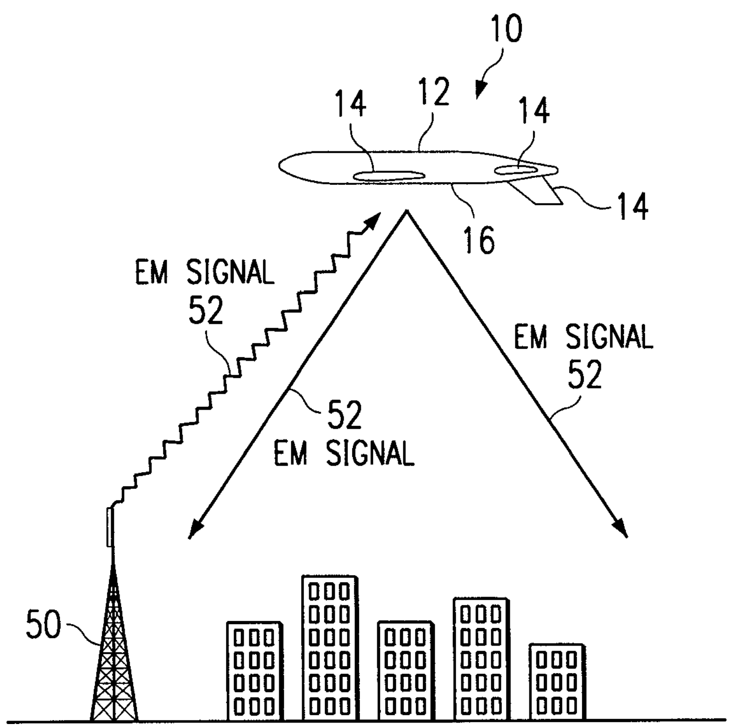
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FIG. 5

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 00/05829

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04B7/185 B64D5/00 B64C39/02 B64D39/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 B64D B64C H04B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A Y	US 4 995 572 A (PIASECKI FRANK N) 26 February 1991 (1991-02-26) abstract figures 1,2,4,5A-5D column 1, line 1 -column 2, line 45 column 3, line 9 -column 5, line 23 column 5, line 7 -column 8, line 43 ---	9,10,12, 22,24 1-4,6-8, 11,13-21 13,21
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[X] Further documents are listed in the continuation of box C.

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Date of the actual completion of the international search	Date of mailing of the international search report
16 May 2000	24/05/2000

Name and mailing address of the ISA	Authorized officer
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INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 00/05829

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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X	DJUKNIC G M ET AL: "ESTABLISHING WIRELESS COMMUNICATIONS SERVICES VIA HIGH-ALTITUDE AERONAUTICAL PLATFORMS: A CONCEPT WHOSE TIME HAS COME?" IEEE COMMUNICATIONS MAGAZINE,US,IEEE SERVICE CENTER. PISCATAWAY, N.J, vol. 35, no. 9, 1 September 1997 (1997-09-01), pages 128-135, XP000704432 ISSN: 0163-6804 the whole document	22-25
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