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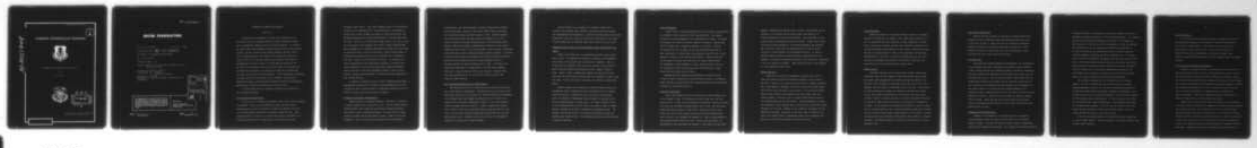

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FOREIGN TECHNOLOGY DIVISION

PROSPECTS OF AIRSHIP APPLICATIONS

by

Hsu Te Pao

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EDITED TRANSLATION

FTD-ID(RS)T-2043-77 19 December 1977

MICROFICHE NR: AD-78-C-000039

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English pages: 12

Source: Hang K'ung Chih Shih, Peking, No. 8, 1976, pp. 30-32.

Country of origin: China
Translated by: SCITRAN
F33657-76-D-0390
Requester: FTD/WE
Approved for public release; distribution; unlimited.

PREPARED BY:

TRANSLATION DIVISION
FOREIGN TECHNOLOGY DIVISION
WP-AFB, OHIO.

PROSPECTS OF AIRSHIP APPLICATIONS

Hsu Te Pao

Along with the developments of science and technology in the past forty years, the structural design of modern airships now makes use of contemporary mechanics theory and large computers. By adopting the light weight high strength titanium-aluminum alloys as the structure material, and the resilient high strength chemical synthetic fabric as the envelope material, the weight of an airship was reduced by a factor of three, the envelope lifetime has increased three times to approximately six years, and the air resistance was reduced by 15%. The ratio of the effective load to the total weight of an airship has increased from one-tenth to the present one-fifth and is approaching the value of one-third of modern airplanes. These changes have revolutionized many aspects of the airship, such as lifetime, carrying load, strength and safety, and have given the modern airships broad prospective applications in both the military and the civilian areas.

Civilian applications of tomorrow's airship can be divided into the following catagories:

Heavy Equipment Transportation

In the course of industrial development, many types of heavy equipment are produced. Some are in the 100-200 ton range and other larger installations may reach the 300-400 ton range; for instance, the rotor of a 500,000 kilowatt hydroelectric generator weighs 250 tons. Other examples include the reactor of a nuclear power plant, the turbine of a power generating station, a cement stall, the refinery tower and

assembled large rockets. Such heavy equipment needs to be transported en masse in its assembled state. The difficulties of overcoming the restrictions of road, bridges and tunnels en route often dictate disassembled shipping in the transportation modes of flat-bed trucks and the train. The cost of transporting a cement stall to its site on land can run as high as the equipment cost itself in some foreign nations. Heavy equipment can be suspended underneath an airship and carried from the production site to the work field with a large airship capable of lifting several hundred tons or even a thousand tons. Airships are also ideal "cranes" in the installation process. In attacking the reactor transportation and installation problems of a nuclear power plant construction, the France electric power company established a special task unit in 1974 with government funding to carry out the planning, research and development of airships with load capacities of 400, 500 and 900 tons.

In addition, airships can also be used in building construction. A prefabricated structure can be lifted up and assembled story by story. Construction time is greatly reduced. Ready-made building can also be carried to remote areas with the help of airships.

Personnel and Material Transportation

Large airships can transport hundreds or thousands of travelers or several hundred tons of cargo at low cost. With an average speed of 100-200 km/hour, their range can reach several thousand kilometers after days or weeks of continuous flight. If nuclear power is used, airships can make long period flights to reach a range of 10 million kilometers. They are therefore most appropriate in long distance

transportation, and intercontinental or global transportation networks can be established. Because of their huge volume, they are excellent for carrying low density and bulky cargo or crates. Airships equipped with pulp conveyor belts and pump systems can transport ore, coal or crude oil directly from their producing sites to the processing plants. Medium or small size airships, unrestricted by airports or other ground conditions, will be able to fly freely between cities, islands, countryside, prairie and remote areas, carrying personnel, material and mail. According to reports, the Soviets have designed a 500 traveler airship and Britain, American and West Germany have also proposed airships for up to a thousand travelers or several hundred tons of cargo. In Britain, test flights have been made on a design model of the nine meter diameter "Sky Ship," a large airship of 400 ton load capacity. Reports claim this large airship will be put into service in three years if the scheme is found practical.

Pipe Installationand Natural Gas Transportation

The installation of oil or natural gas pipes involves long distance and a large amount of engineering. Preparation costs can be high if road and bridge construction are necessary for transporting pipes and equipment. At the present time, pipe lengths are limited to 10 or 12 meters as a result of the train/truck transportation limits. It is time consuming to weld the pipes section by section. A small or medium size airship will be able to carry 100 m long pipes directly from the factory to the field. This not only reduces transportation and welding time, but also cuts down the costs. Airships can also lay sections of pre-assembled railroad on the road bed or install bridges.

Analysis showed it is economical to transport natural gas by airships, and currently Japan, Britain, Soviet Union and West Germany are investigating this possibility. Britain has already started developing 60,000 cubic meter test ships for natural gas transportation, and plans to build large ships of 2,380,000 cubic meter volume by the year 1984.

Transporting Well Towers and Installing High Voltage Transmission Line Towers

Today's drill towers for oil and natural gas wells usually weigh tens of tons. It is generally necessary to transport the disassembled drill tower to the new well site and then put it together. This can be done with the combined effort of several tractors if the terrain is gentle and difficulties are encountered in hill, swamp or mountain areas. Again, a small or medium size airship can easily lift up and carry away the entire drill tower and give us a tremendous saving on time and labor. For well drilling in the ocean, the airship is particularly useful.

Similar problems are encountered in installing high voltage power transmission lines of hundreds of miles stretching over hills, swamps, rivers and canyons. Although the towers are lighter than drilling towers, the amount of engineering work is enormous in erecting towers every few hundred meters in remote areas. If a small airship is used to lift ready made towers to their sites, the saving of work is evident. Besides, airships can be used in checking the transmission lines. The presently used method relies on a checking crew working at night and traveling over rough terrain. This elaborate method can be much improved by using the airships.

Forest Development

Virgin forests in remote mountaineous areas may remain underdeveloped for hundreds of years because of their inaccessibility. The biggest problem in forest development is the transportation of lumber. According to estimates, an airship of 200 ton capacity is capable of transporting 200 m^3 of lumber over a thousand kilometers in ten hours. Tractors can only move 10 tons of lumber at one time with additional work of road construction. Airships have been extensively used for years in the Douglas fir forests in the western United States. Reports claim that 18 ton capacity airships have been built for lumber transportation. The advantages of using airships in canyon, swamp and hilly areas are the elimination of road construction costs, the protection of young forests and the reduced loss in lumber.

Equipped with the necessary instrumentations, airships can also be used in forest identification and distribution surveys, in estimating lumber reserves, plotting forest maps, spraying fertilizer and pesticides, planting over large areas and so on.

Forest Fire Prevention

Fire is the greatest threat to forests and can cause enormous loss if not checked in time. Fire destroys not only forest trees but also wildlife, both of which are very difficult to replenish. Statistics showed that there are two hundred thousand forest fires a year, with the United States particularly prone to forest fires. Reports show that forest fires occur every fifteen minutes in the United States destroying 100 acres of forest on an average; this amounts to a loss of three hundred to five hundred million dollars per year. Special crews and towers are established in fire prevention and fighting -- with rather low efficiency

however, considering the immense area of forests. Many nations use the airplane in fire control and the United States also makes use of resource satellites in forest fire detection. Such practices are very costly and the technologies involved are complex. A small size airship carrying detection instruments, fire fighting equipment and personnel may cruise over forest area for extended periods of time to report fires and to spray chemical fire extinguisher directly. If water is avilable nearby, airships can pump the water through pipes for fire fighting. Personnel and equipment stationed at the base can be transported to the site rapidly by airships. Japan reportedly plans to use airships for fire fighting in urban areas.

Mineral Detection

Armed with the necessary instruments, airships can be used in large area mineral surveys and outperform airplanes in both accuracy and costs. Because of the large volume available in airships, computers and a large amount of equipment can be put on board; the steady flight and low noise also contribute in the accuracy. It has been calculated that the work volume in three months of two small ships, each with fifteen workers, is equal to that of several large detection crews of two thousand workers in the same period. Another advantage of airships over airplanes is that repeated tests can be carried out with the airship hovering over the sites. Workers can be lowered to the ground for site marking if necessary. Airplanes, on the other hand, will have to fly back to the airport before a confirmation group can be organized, and even then, it has been a problem to re-locate the site.

Ocean Exploration

Covering two-thirds of the earth's surface, oceans are an immense reservoir of resources to be tapped. Here, again, small airships can do alot in exploration and data collection on ocean temperature, streams, color, marine life, pollution and many other important parameters vital to ocean development and navigation of ocean liners. Airships will also find use in locating schools of fish, in tracing whales and directing fishing boats for the catch. Scientific investigations can be carried out with the equipment and personnel on board while flying over the south and north poles, deserts and other remote areas.

Disaster Rescue

In natural disasters such as earth quakes, floods, typhoons and landslides, there is often damage to roads and airports which prevent the rescue crews and material from rapidly reaching the disaster area. This also causes problems in evacuating people and injuries out of the emergency area and results in increased casualty and loss. Unrestricted by roads and airports, airships can immediately deliver food, medical supply, water pumps, and bulldozers to the disaster area and airlift victims to safety. Airships can also be converted to makeshift hospitals, or be used in supplying electrical power to the ground or illumination at night. It has recently been proposed that airships be used as salvage boats in rescue missions at sea. Previous experience showed that airships can fly in seven or eight degree winds (moderate to fresh gale). Isolated incidences exist where airships survived twelve degree winds of hurricane intensity. With modern equipment, airships can be very useful in rescue missions at sea.

Agricultural Applications

Airships can take the place of airplanes in sowing and spraying, feeding the fish in lakes and reservoirs and broadcasting small fries of fish into the water. Large scale land use surveying, photography, mapping and wildlife surveying are additional applications. Rapid transfer of produce of short shelf life, such as vegetables, fruits and fresh fish can be done easily with airships.

Pollution Watch

Along with more advanced industrial developments, the contamination of our atmosphere and water environment is becoming a serious problem. A small airship carrying a few hundred kilograms of detection instruments, television cameras, and controlled by radio signal can be used to patrol the space above a city. The air pollution level of any chosen point can be monitored accurately and signals from the pollution sources such as steel factories, oil refineries and large chimneys can be transmitted to the control center on the ground and life images displayed on the television screen. Manned airships can fly over bodies of water and take samples for analysis. Spilled oil can be treated by chemicals sprayed from an airship. Japan and some other nations have been using small ships for pollution monitors because of their simple construction, easy operation and low cost.

Communication and Broadcasting

Nowadays, the transmission of television, radio and telephone signals generally relies on cables or relay towers of a few hundred meters in height. This practice involves a great volume of engineering, high costs and complicated technology. The technique of using helium-filled

stationary balloons as broadcasting relay is quite simple and results in increased efficiency and range at a lower broadcasting power. For example, balloons with broadcasting equipment placed three to five kilometers above ground will cover an area of 400 km diameter, or more than 100,000 km^2, equivalent to the area covered by fifteen broadcasting towers. In 1975, the United States provided South Korea a balloon system for civilian telephone, television and radio transmission use. The system covers an area of 120,000 km^2, 30% greater than the entire area of South Korea. The balloon systems described above can stay afloat indefinitely and function even under wind speeds of 190 km/hr (12 degree hurricane). They are referred to as "Low Altitude Communication Satellites" but their signals can be received by ordinary radio and TV sets and hence they do not require elaborate ground station installations.

The economic advantages can be illustrated in the following example: To cover a 750,000 km^2 area, or 200 km along the Peking-Shanghai-Kwangchow railroad, six such balloon broadcasting systems can be installed between Peking and Shanghai, Shanghai and Kwangchow. Each system can carry a set of television programs, a set of FM radio programs and 960 telephone lines simultaneously. It can also serve as the relay of a broad band video signal broadcasting. Other communication signals can be handled when necessary -- such as real time video or radar data, weather and map information, flood and fire alarm signals can all be relayed through the system to the control center.

Balloon broadcasting systems can be easily installed, transferred or used in remote regions. They are being used in the United States, Iran and many other countries.

Planet Observation

It is believed that the surface condition, atmosphere composition and biological experiments can be studied by airships floating above the surface of other planets. Such airships can also take part in space station or space shuttle plans. The most likely planet is probably Venus since its atmosphere is believed to contain large amounts of gaseous hydrocarbons which may have enough buoyancy to support airships.

Sea Patrol and Anti-Submarine Operations

Airships are highly effective in patrolling the sea, and in anti-submarine operations they can carry out observations of the air, the sea, and the underwater simultaneously with reliability and economy. During the first and the second world wars, Britain, France and the United States all had used special teams of anti-submarine and escort airships. Airships were gradually eliminated due to their low speed and survival ability, and to the rapid improvements of submarines and the stagnation of sonar technologies. With today's submarine-detection techniques, airships can again be used in anti-submarine operations.

Large arrays of phase control radar and antennas can be installed on the two sides of an airship, and computers and other auxiliary equipment can be inside the ship. Such airships can serve as an early-warning system since they are capable of detecting air or sea targets, including ballistic missiles launched from enemy submarines at a great distance away. A sonar field can be set up over a large area in the sea and underwater sonars can be dragged along by low-flying airships for submarine activity detection. Airships can also raid the target with the guided missile

and torpedo on board. With airships' long range and low fuel consumption, air and sea patrols can be ensured day and night over an extended period of time. For countries with long shorelines and extended sea territory, these airships are ideal patrols. It was reported in early 1977 that the British Navy was preparing six squadrons of airships equipped with electronics gear to protect their North Sea oil facility and fishing ground against the harrassment of submarines and fishing boats of the Soviet Revisionists.

Border Lookout

Airships equipped with electronic surveillance instruments hovering over key areas near the border serve as lookout posts and communication links between patrol units and command posts. Such surveillance balloons are quite convenient to install or recover. The U.S. Imperialists used such methods in the Vietnam invasion war. Recently, the U.S. installed a special target detecting radar on stationary balloons to spot even very slow movements of troops. According to estimates by the U.S. Defense Department, for night/day low altitude observation, the cost in using stationary balloons in only one-tenth of that using airplanes.

Military Transportation and Training

Under normal conditions, airships are used in transporting troops and deliverying water and material supply to islands. In emergencies, airships can airlift massive troops, equipment, tanks and artillery to their destination in the front and carry casualties and injuries to the back. Small airships are used in parachute jump training and signal corps training.

Looking into the future, airships have great potential for many new and important applications in the years to come.