Example of research paper on hydraulic aircraft elevators

Engineering, Aviation

Hydraulic aircraft elevators have as their main purpose the transporting of aircraft between the flight deck and the hangar deck. Although this is the main function of the elevators, they are at times used in transporting equipment and cargo. Mostly, these elevators are used in aircraft carriers. Assault ships like LPH's and LHA's also have these elevators. Aircraft elevators make use of hydraulic engines, wires and ropes when lifting and lowering the platform (Chovil, 16). Some of the aircraft elevators are the deck edge and the inboard. In naming these elevators, reference is made to the location on the ship the elevator platform takes. As the name suggests, inboard elevators are found inside the ship's hull. Although they are located in different areas, the deck edge elevator and the inboard elevator apply similar principles when operating. They also assume a similar arrangement pattern. Below is a basic diagram of a hydraulic aircraft elevator.

Retrieved from (http://www. mathworks. com/products/simulink/model-examples. html? file=/products/demos/stateflow/fdir/FDIR_overview. html)

Essentially, the structure of the aircraft elevator is designed in such a manner that it can withstand the platform's weight, the wind loads, the rated load and the wave loads when the aircraft is moving. It is essential that aircraft elevators are lightweight, but capable of supporting the rated load properly. In most cases, the elevator platform takes a rigid nature to sufficiently support the load with little deflection. This is essential in allowing the insertion of platform lock bars. This provides enough support at the deck without taking into consideration the position the load takes on the platform. Deck edge elevators use folding platforms in order to allow the aircrafts sufficient clearance (Chovil, 23).

Aircraft elevators employ the technology of hydraulic engines. These engines are responsible for translating hydraulic pressure to the required force of lifting the elevator platform. The hydraulic fluid which is under intense pressure is directed to the hydraulic engine, forcing the travelling sheave to block from the anchor assembly. This means that the wire ropes in effect lift the platform. At this time, gravity has the impact of lowering the platform. This means that the hydraulic fluid is forced out of the engine (hydraulic engine). The main control valve meters the hydraulic fluid in order to control the platform’s decency and the rate of the lift. At this point, the travelling sheave stops the engine frame, effectively supporting the platform.

Aircraft elevators have two types of hydraulic engines: the piston type and the ram type (Peters, 32). The piston engines work in such a manner that they pull the travelling sheave from the anchor structure. In such types, hydraulic engines are smaller in size when compared to the ram types. The key reason for this is that the engine will be loaded, eliminating the forces. The hydraulic pressure is essential in that it is applied to the engine’s rod end. This forces the rod to take up the ropes. Upon fully retracting the piston rod, the platform locates itself in the flight deck. Extending the piston rod fully moves the platform to the hangar deck. The platform’s weight is important in providing the needed force for the piston rod to extend.

Hydraulic engines that are ram type have a large ram which pushes the sheave away from the structure of the wire rope anchor. The ram normally has a large diameter, essential for providing the necessary cross-sectional area for the platform to be lifted. The large diameter is also important in order to ensure the platform resists the load (Peters, 43). For the elevator platform to be raised, the ram type is made in such a way that it applies the hydraulic pressure to the engine. This forces the extension of the ram, taking up the ropes. Extending the ram fully shoots the platform to the flight deck. The platform however relocates to the hangar deck upon fully retraction of the ram. In retracting the ram, the platform’s weight is essential in providing the needed force.

In aircraft elevators, hydraulics play key roles. Such roles may include providing the aircraft the motive force the elevator platforms need. In aircrafts, the hydraulic fluid takes the form of a phosphate ester, which is in accordance to MIL-H-19457C. Aircraft elevators at times employ hydraulics of low pressure. The pressure always differs between as low as 1000 psi and 2800 psi (Petroff et al. 54). The variance of the operating pressures does not affect the similarity of the aircraft operators. In all types of aircraft elevators, the flow to the hydraulic engine and the flow from the engine are controlled by the main flow control valve.

Aircraft elevators control the plane’s longitudinal attitude. This is achieved by lifting the wing and changing through the change of the pitch balance. All elevators are hinged to an adjustable or fixed rear surface. This makes the horizontal stabilizer or the tailplane of the aircraft. Technology has it that integrating flight control systems such as elevons, ailerons and flapersons to undertake aerodynamic purposes has a number of advantages. Some advantages may include less cost, less mass and less inertia. These are responsible for stronger and faster response. It also means that there will be lesser parts moving, hence requiring less maintenance.

Hydraulic aircraft elevators have more than two main pumps that work in a parallel manner to supply enough fluid to the accumulators and the pressure tanks (Crampton, 76). These pumps are always controlled by pressure switches that are located in the high-pressure accumulators. The main pumps of the aircraft elevators are variable displacements. However, there are systems that have displacement pumps that are fixed. Normally, the pumps perform the same task of supplying fluid. At times, however, one pump can be sufficient to operate the elevator.

Air systems also play a crucial role in the aircraft elevators. Accumulators and high-pressure tanks comprise of low and high-pressure air systems. In most cases, the system uses nitrogen to pressurize the hydraulic fluid. The fact that gases are highly compressible when compared to fluids is an added advantage. Whenever the fluid enters the tanks, the gas cannot escape as it is contained in a system that is closed. This means that the gas becomes more compressed, acting as a spring in pressurizing the fluid until when needed.

In most cases, the tanks have a direct connection to the system on one end. The other end is connected to the gas flask. A piston separates the compressed gas from the hydraulic fluid. To protect the system from over-pressurization, the relief valves are put into used. With such an efficient system, it is possible for the system to supply large fluid volumes in a short period. When this is the case, the system works efficiently, even when the main pumps are smaller in size.

Works Cited

Chovil, D. V. Advanced composite elevator for Boeing 727 aircraft. Washington, D. C.?: National Aeronautics and Space Administration, Scientific and Technical Information Branch, 1981. Print.

Crampton, R. D. HYDRAULIC SYSTEM SELF TEST TECHNOLOGY. Ft. Belvoir: Defense Technical Information Center, 21968. Print.

Peters, Patrick J. The Effects of Elevator Rate Limiting and Stick Dynamics on Longitudinal Pilot-Induced Oscillations. Ft. Belvoir: Defense Technical Information Center, 1997. Print.

Petroff, Alex. APPLICATION OF CIRCULATION CONTROL TO AN AIRPLANE OF MILITARY LIAISON TYPE. Ft. Belvoir: Defense Technical Information Center, 1953. Print.

Simulink. (n. d.). Stateflow. Retrieved October 10, 2014, from http://www. mathworks. com/products/simulink/modelexamples. html? file=/products/demos/stateflow/fdir/FDIR_ove