Aircraft Landing Gear Layouts and Functions

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ABSTRACT: During landing and ground operations, an aircraft landing gear carries the entire weight of an airplane. The major structural elements of the aircraft are connected. The type of equipment depends on the configuration and planned operation of the aircraft. Many landing gears are fitted with wheels for ease of service, for example, on airport runways. Certain hardware is fitted with skids to this end, such as helicopters and balloon gondolas as well as tail-dragger planes. The skis can be fitted with the landing gear from and into frozen lakes and snowy regions. Aircraft flying to and from the water surface have a landing system with pontoons. Any type of landing gear used, the aircraft shall be viewed as a portion of the landing gear structure, including instruments, braking systems, retraction mechanisms, sensors, alert devices, cowls, fencing and structural elements required to connect the train.

***KEYWORDS: Equipment, Gears, Landing, Mechanism, Planes, Structure, Amphibious aircraft*.**

INTRODUCTION

Landing gars systems are important parts for an airplane and is conventionally designed according to the aircraft's structure. This is done due to the importance and role on the aircraft's structural configuration. In the initial aircraft design cycle the landing gear system detail is considered because of its very long development cycle time [1]. There is a need of development of landing gear system with minimum volume, weight, short development cycle and less life cycle cost. But these parameters possess a lot of challenges which are needed to be met by developing advanced technology, analysis, materials, production, process methods.

Landing gear's most important feature for an aircraft to provide shock absorption during taxing, landing process and taking off. It is constructed as such to dissipate and absorb the kinetic energy caused due to landing impact, therefore it is necessary to reduce load impact to the airframe [2]. The landing gear helps in braking of airplane with the help of wheel steering technology and conventionally made retractable in order to considerably drop the drag caused due to obstruction created by airplane body while flying. Many forms of landing gear configurations are available. In fact, two styles of machinery are that combinations. Amphibious aircraft are equipped for landings on water or dry landing with clothing [3]. The equipment is fitted with pontoons for landings on rough surfaces and extensible spokes. The use of skis and wheels on sliding surfaces and clear runways in aircraft is performed in a similar way. The skis are usually retractable so that the wheels can be used when necessary.

LITERATURE REVIEW

1. Landing Gear Arrangement:

a) Tail wheel type landing gear (also called traditional gear),
b) Tandem landing gear and
c) Trike form landing gears

are the main configurations required to allow landings.

1.1. Tail Wheel-Type Landing Gear:

Tail wheel landing gear also called as standard gear is installed at the front portion of the centre of gravity of airplane in such a manner that the tail of the airplane requires support from a third wheel brace. Few of previous designs early designs required to use a skid instead of a tail drum. It slows the plane down while landing and maintains sideways movement of the airplane. When conventional gear is installed with traditional gear, the angle of fuselage of the aircraft allows the use of a long propeller to account for the newer, less efficient engine configuration. The improved stability of the forward fuselage provided by the tail wheel landing gear is also useful for usage on or off unpaved runways. For the sake of weight savings correlated with the comparatively small tail wheel arrangement, the aircraft are currently produced with traditional machinery (Figure 1).

Figure 1: Landing Gear

The increase of the length of runways with harder surfaces has resulted in skidding the tail in place of the tail wheel redundant. Differential braking is used in order to conserve directional power prior to the speed requires rudder stability. Most commonly steerable tail wheel is used along with rubber and rubber pedals with cables for damping [4].

1.2. Tandem Landing Gear:

As name represents, the main gear of the aircraft is connected to the tail gear across the aircraft's length axis. Many strategic bombers have a tandem machine, including the B-47 and the B-52, and a U2 surveillance aircraft [5]. The VTOL Harrier has a tandem gear, which is assisted by little extender gear below the wings. The only method to use the wings of lightweight structure is by positioning the gear under the fuselage only.

1.3. Tricycle-Type Landing Gear:

This is the most commonly used landing gear system for the aircrafts.

1.3.1. For big and small aircraft with the following benefits, tri-cycle landing gear is used:

- This enables the brakes to be applied more forcefully without stopping, which enables higher rates of landing.
- Improved visibility from the boat, especially during ground and landing manoeuvring.
- Eliminates the chances land looping formation. Since the COG of the aircraft is ahead from the main gear, the forces exerted at COG appear, as in the case of a tail wheel type, to keep the aircraft rolling rather than spinning.

Many aircraft are not controllable for the nose gear with a three-cycle style landing gear. It just rolls as the steering is done by differential braking during the taxi. Almost everybody, though, has steerable nose devices [6]. Usually heavy aircraft use hydraulic strength to control the nose gear. A separate flight deck tiller gives power. A three cycle landing gear is used when the main gear is attached to the fuselage or the fixed wing structure. The number and location of the rollers on the main gear vary. There's a lot of main gear for two or three axes. The aircraft's weight is distributed across a larger area by several spokes. It even has a safety buffer if a tyre falls. Four or more wheel assemblies can be used for heavy aircraft on each main engine. The connecting process depends upon the bogie where two or more rollers are attached to a landing gear. The quantity of wheels throughout the bogie is dependent on the weight of the aircraft's gross configuration and the surface condition on which the equipped aircraft has to land. There are several sections and assemblies in the triple-type landing gear system. These involve air/oil wires, gear alignments, recovery mechanisms, protection equipment, steering systems, installation of wheels and braking, etc.

2. *Fixed and Retractable Landing Gear:*

At least two categories of aircraft landing gear are used that is fixed or retractable type landing gear where majorly the light weight aircrafts have fixed type landing gear. It confirms that the gear is attached to the aircraft and stays open to the flat flow whilst the airplane is being flown. Aircraft weight is applied by systems for retracting and storing landing gear to eliminate parasite flow. On slower aircraft it is not necessary to mitigate the penalty of the added weight by raising the flight, while utilizing the fixed gear. When the aircraft's speed decreases, given the mass of the structure, the drag generated by the landing gear is decreased and a means to remove the gear are needed to reduce parasite drag [7].

Majorly the drag produced during landing of light weight airplane, gear can be aerodynamically minimized and the airflow may be optimized beyond the dominant compositions with the introduction of fastener or wheel trousers. A low, smooth wind profile greatly decreases the friction gear [8].

The landing gear in the future can be de assembled during passing through wing or fuselage compartments. When in these furnaces, the aircraft is out of the slipway and doesn't suffer parasite drag. The gear that can be most retracted is designed with a similar fitting screen to reveal the skin of the aircraft while the aircraft is completely withdrawn. Most of the aircraft have doors that open independently, enabling the engine to reach or leave, and then shut again.

2.1. Shock Absorbing and Non-Shock Absorbing Landing Gear:

The force of impact on an aircraft should get be controlled through landing gear while landing. The two methods are to achieve this;

- Change the shock energy to move it to a specific intensity and duration in the aircraft than the one effective burst of impact and
- Remove it by turning the energy into heat.

3. Leaf-Type Spring Gear:

In order to keep low weight many airplanes use lightweight aluminium, spring steel and composite struts to land and to dissipate it to the airframe at an unhazardous pace. The gear initially flexes and pressures on the original location are moved. Thousands of Cessna monometers are one of the most common examples with respect to non-shock-absorbing equipment. This form of landing gear belt made of lightweight materials is lighter and more durable, and it does not corrode [9].

3.1. Rigid:

Most of the old airplanes were built with landing gear struts with welded steel prior to flexible spring steel struts. This type of gear helps to move shock load to the airframe. Use of pneumatic tyres helps to reduce impact. The usage of rigid gears for landing with no significant damage to conventional aircraft utilizing a skid form gear. For eg, rotorcraft usually have low-impact landings that can be taken by the aircraft directly by the rigid equipment (skids).

3.2. Bungee Cord:

Bungee cords are also associated for non-shock absorption equipment. The structure of the gear causes the strut mounting to rotate on the force of the landing. Bungee cords are used between rigid airframe and gear assembly to take on loads & return to the airframe at a non-damaging pace, Bungeo Cords are positioned between the rigid airframe framework and the versatile gear assembly. The bungees are made up of elastic rubber cords which must be checked. On certain aircraft landing gear, solid, rubber-type donut coils are often used.

3.3. Shock Struts:

This is the most popular form for discharging aircraft shocks. It is extended to all-size planes. Shock struts are hydraulic units containing themselves to support the aircraft on the ground and protect the framework at landing. To ensure proper activity, they must be checked and routinely serviced. There are several different shock strut types, but most of them work in the same way. The debate below is common in nature. Consult the manufacturer's servicing manuals for details regarding the design, function and repair of a particular aircraft shock.

A traditional Pneumatic/Hydraulic Strut is designed to withstand and dissipate shock charges of compressed air or nitrogen mixed of hydraulic oil. Often it's called an air / oil or oil strut. Couple of telescoping cylinders or tubes connected at the exterior ends are formed as a shock line. The top cylinder is fixed to and does not shift to the plane. The lower cylinders are called the piston and the upper cylinders may be swiped easily in and out. This comprises of two chambers. Hydraulique fluid is often used in the lower chamber, while compressed air/nitrogen is used in the upper chamber. A gap between the two cylinders lets the fluid into the top cylinder room from the bottom chamber while the strut is compressed.

To monitor the fluid flow velocity the shock struts are used from the bottom to the top chamber. The taper of metering pin in the orifice regulates it automatically. The upper chamber will be more flexible if a small part of the pin is in the cavity. With less fluid going by, the width of the metric pin in the cavity is decreased. Pressure build-up induced by stretching and heat pulling the hydraulic fluid into the aperture. The heat is converted into the energy of effect. The arrangement of the strut dissipates it. A measurement tube is used on certain kinds of shock struts. The operational principle for the shock struts is the same as in measuring pins and that the troughs in the metering room regulate the fluid movement through acceleration from the bottom to the top chamber. The shock strut continues to stretch quickly as the stress is taken off or recover. At the end of the stroke this may have a strong effect and harm the stroke. The shock struts are usually fitted with a snub or damping system to avoid this. The fluid flux during the extension stroke is decreased by a reverse valves on the piston, or a reverse valve. This reduces the motion & prevents harmful impact forces.

Shock struts lacking an integral axle provide requirements for the mounting of axle assembly at the end of the lower ring. Both shock strut upper cylinders are wired in an acceptable way to link the strut. A valve brace is normally located in the upper chamber of the shock strut. This is placed on the top of the cylinders or around them. The valve offers a way of hydraulic fluid filling the strut and air or nitrogen inflating it, as the maker stated. The slipping connection between the top and bottom telescopic cylinders is covered with an embedding plate. It is attached to the exterior tubes at the open top. In the lower bearing and gland nozzles of most shock struts, a sealing gland wiper ring is often mounted. The piston slips through water, dust, ice and snow onto the bottom of the packaging glass and top of the cylinders. Cleaning the part of the piston exposed periodically lets the wiper carry out his task and eliminates the risk of injury to the sealing gland that may contribute to leakages.

Torque connections or torque devices are used in liners in order to hold the piston and wheels balanced. The set upper cylinder is attached to an end of the ties. At the other hand, the lower cylinders (piston) are connected and they cannot spin. It aligns the rollers. If you stretch the bolt, such as during taking off, the ties always hold the piston at the end of the upper cylinders. A finding cam assembly to hold the gear balanced is installed for nose shock struts. The cams are located right in front of the wheel and axles while the spur of shock has been stretched completely. This makes the nose wheel go in while the nose gear is removed which stops the aircraft from sustaining structural damage. For fact, as the stretch is completely expanded, it aligns the rings toward the longitudinal axes of the aircraft before landing.

Nose gear struts also have a locking or disconnecting pin to enable for easy turning when towing or placing the aircraft on a ramp or hangar. The decoupling of the pin allows the wheel forking spindle to move 360 ° on certain planes, enabling the plane to move within a small distance. The nose wheel of any aircraft should never be rotated past the airframe specified points. Nose and key rods for shock are also fittings for jack points and towing lines on several aircraft. Put jacks under the points listed often. The towing bar can only contain a plate to the Shock struts that provides directions for the fluid filling in the strut and for inflating the stretch if towing lugs are given. Usually between the filling inlet and air valves are connected to the guidance board. The best hydraulic fluid form to be used in the strut and the strength at which the strut is inflated. It determines. Before loading a strut with hydraulic fluid or infecting it with air or oxygen, it is important to familiarise with such directions.

4. Small Aircraft Retraction System:

For a rise in the height of light aircraft, the drag created by the wind by the landing gear is stronger than the generated drag created by the retractable landing gear system's additional weight. Most small aircraft also have retractable engines. A number of unique designs are available. The easiest requires a lever manually attached to the hardware on the flight deck. The pilot extends and removes the landing gear by working the lever increasing mechanical advantage. This is commonly used to reduce the necessary strength with a roller wheel, sprockets and a hand crank.

Small aircraft are also used with electrically powered landing gear systems. The electric motor and the reduction of the gear are used for a whole-power machine. The motor's rotary motion is transformed into a circular movement to drive the lever. Only with the comparatively limited gear on smaller aircraft is this feasible.

5. Large Aircraft Retraction System:

Nearly often, hydraulic control is required in large aircraft retraction systems. Typically, the motor adapter control is powered out of the hydraulic engine. Hydraulic auxiliary pumps are common as well. Many equipment used in a retractor hydraulic system include control levers, lever valves, up locks, down locking valves, series valves, prior valves and other basic components of the hydraulic system. This machine are related so that the landing gear as well as the landing gear doors can be removed and extended properly. The correct function of the retraction mechanism is very critical for every aircraft landing gear. This is an example of a basic broad hydraulic network with landing gears. The mechanism is on an airplane with doors open and shut until the gear is extended and withdrawn. The doors of the nose gear operate by mechanical contact without hydraulic control. In many planes, there are several facilities and service door arrangements. Many aircraft are fitted with doors that suit the wheel well after expanding the gear. Many doors have been placed mechanically outside of the gear to allow the door to be secured by the gear and the skin of the fuselages as it is pushed inward.

The three locks are pressurized and opened to remove the equipment. Simultaneously, a pressure-restrained fluid is supplied to the upside side of the piston by an unrestricted valve for power the actuator cylinder on each ring. It forces the machine onto the drum. The fluid pressure is often added to two series valves (C and D). The function of the gear door must be managed to happen after the loading of the equipment. The doors are closing and the door actuators are being stopped. When the gear cylinder is completely pulled back, the valve series dippers opening up the valves mechanically touch them and cause fluid to be flowing through the close side of the door actuator cylinder [8].

In the drop-down part, the selector is attached to decrease the speed. From the hydraulic converter to the nose gear which lifted the nose gear goes hydraulic pressurised fluid. Fluid travels to and extends the actuator hand down. Fluid also flows on the open part of the system to the primary door actuators. The series valves A and B trap the fluid to unlock principal gear hooks when the doors expand, which keep fluid from entering the bottom of the main gear actuators. In both sets of valves, the door actuator pulls the plungers out when the doors are completely shut.

Imported, compressed and released the critical equipment. In order to extend the chain, the centre actuators of the gear ring are supplied down by the open sequence valves. Fluid flows side by side into the reverse hydraulic system from each of the primary transmission cylinders through valve limitations. The limiters delay the gear extension to avoid harm to the impact. Numerous retraction mechanisms are designed for hydraulic landing gears. Instead of manually controlled series valves, priority valves are also used. This regulates the triggering of any gear part by hydraulic pressure. The aircraft repair manual includes details on each gear device. This vital device ought to be thoroughly known to the aviation technician with organizational and repair requirements [9], [10].

DISCUSSION & CONCLUSION

There are several challenges for developing landing gear with minimal weight, low volumes and high efficiency, safer lives, and a lower life cycle rate. It is also necessary to reduce the size and cycle time of the landing gear while complying with all protection and regulatory specifications. Over the years, several innovations were developed to tackle the problems of design and production of landing gears. These innovations are advanced through the years and will continue to develop in the future in the new landing gear system. The potential construction of aircraft landing gears poses several different problems in the architecture, implementation of components, construction and analytical procedures. Such problems may be faced by utilizing modern technology, products, analytical tools, procedures and manufacturing practices, while meeting all regulatory health criteria. The time and expense of production was greatly minimized by implementing practical modelling and improving design software. The usage of stronger components, composites and innovations such as active damping power, electrical devices, CAX, KBE and safety tracking technology will lead the construction of a landing gear in the next few days.

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