PHASE 4

UNDERCARRIAGE

BASIC UNDERCARRIAGE

General

The main landing gear consists of that portion of the machine which forms the principal support of the aircraft when on land or water. It may include any combination of wheels, floats, skids, shock-absorbing mechanisms, brake and steering operating mechanisms, retracting mechanisms with their controls and warning devices, fairings and framing or structural members necessary to secure any of the above to the primary structure.

The auxiliary landing gear consists of tail wheel, or nose, wheel installations, pontoons, skids etc., together with the necessary structural re-inforements which have been incorporated in the aircraft to facilitate and safeguard landing and handling on ground or water.

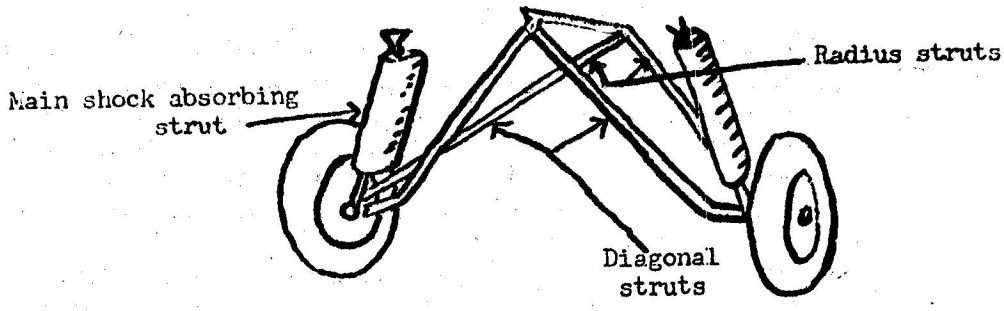
Types of Undercarriages

(a) Through Axle Undercarriage

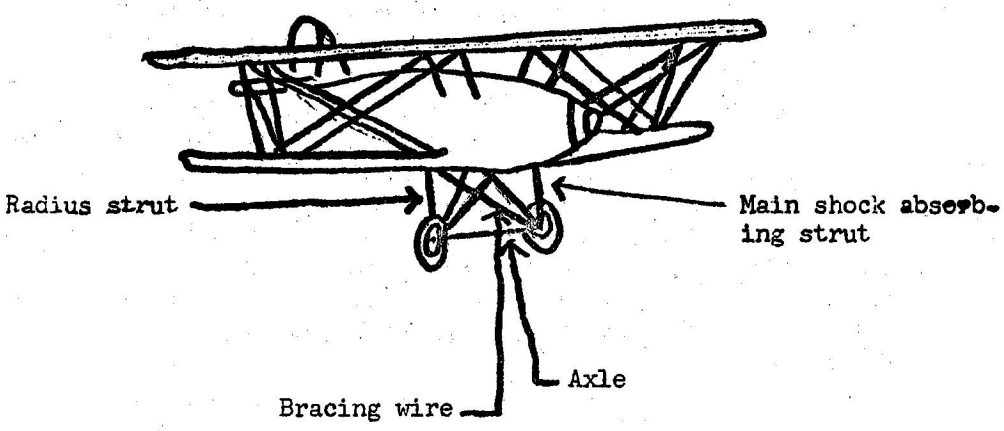
The arliest type of alighting gear was longitudinal skids which were soon replaced with wheels as the shock of landing was severe. Thefirst type using wheels was the THROUGH AXLE. This had one transverse axle supporting two wire spoked wheels with a vertical strut from wither end of the axle mounted to the longerons. This was braced against backward loads with two RADIUS STRUTS which were mounted at an angle to the vertical strut, either forward or backward, running also from either end of the axle, to the longerons. The structure was braced transversely by diagonal bracing wires. The tires absorbed some of the shock of landing, but later crude efforts were used to increase the shock absorbing agent by the use of bungee cord to attach the axle to the vertical and radius struts. (see Fit. 31)

(b) Split Axle Undercarriage

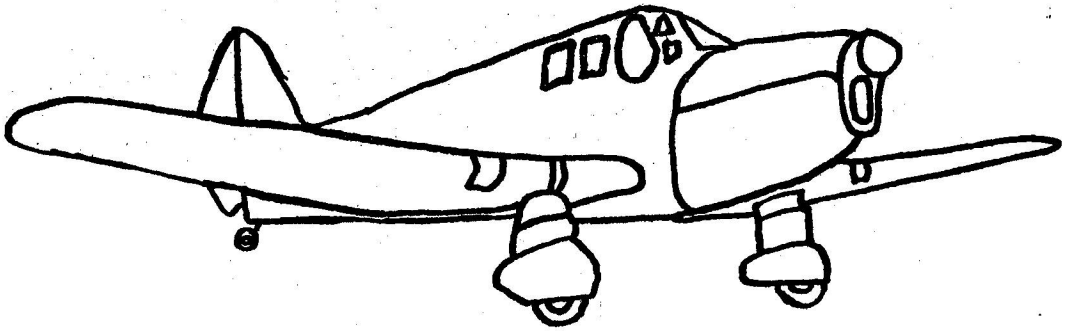
The through axle under carriage was fouled by long grass and other obstacles whilst the aircraft was taxiing, so an attempt to avoid this was made by dividing the axle and curving each resulting separate axle up to the fuselage and mounting them between the two vertical struts. This was known as the SPLIT AXLE type. Sometimes on this type the split axles are joined part way from the wheels to the fuselage and two diagonal struts installed from this joint to the fuselage. (See Fig. 32)



SPLIT AXLE TYPE
(Fig. 32)



THROUGH AXLE TYPE
(Fig. 31)



DIVIDED UNDERCARRIAGE

(c) Divided Undercarriage

The split axle undercarriage was a slight improvement, but still the bracing was in the way of external bomb racks, torpedoes, etc., and was not conductive to streamlining to reduce its drag. The difficulties were largely responsible for the development of the DIVIDED undercarriage, where each wheel was mounted on a separate unit. This permitted a wider distance between the wheels(track), which added to stability on the ground for landing and taxiing; also, the short axle and absence of cross bracing permitted the units to be effectively faired with "PANTS". (See Fig. 33). In this type, the upward load is taken by the main shock struts. The majority of undercarriages on modern machine are of the divided type which also incorporate some type of retracting mechanism, to reduce drag to a minimum.

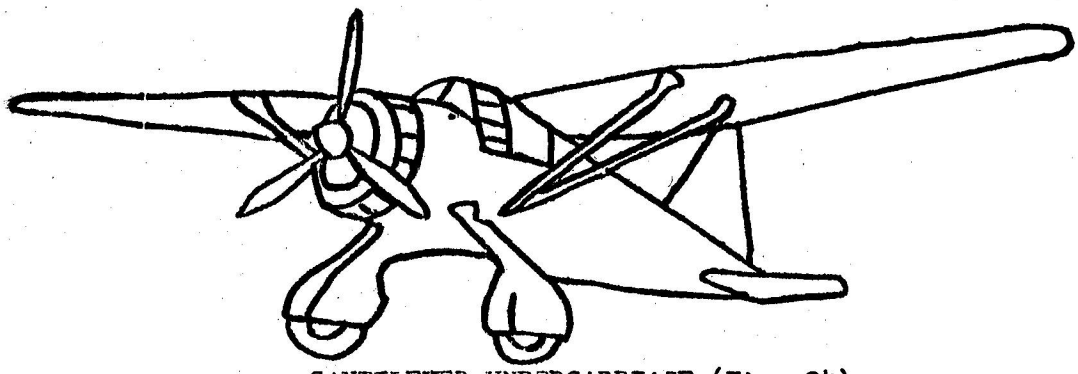
(d) Cantilever Undercarriage.

A less common type of undercarriage is the CANTILEVER, where the entire structure is a "U" shaped girder, requiring no bracing members (See Fig. 34).

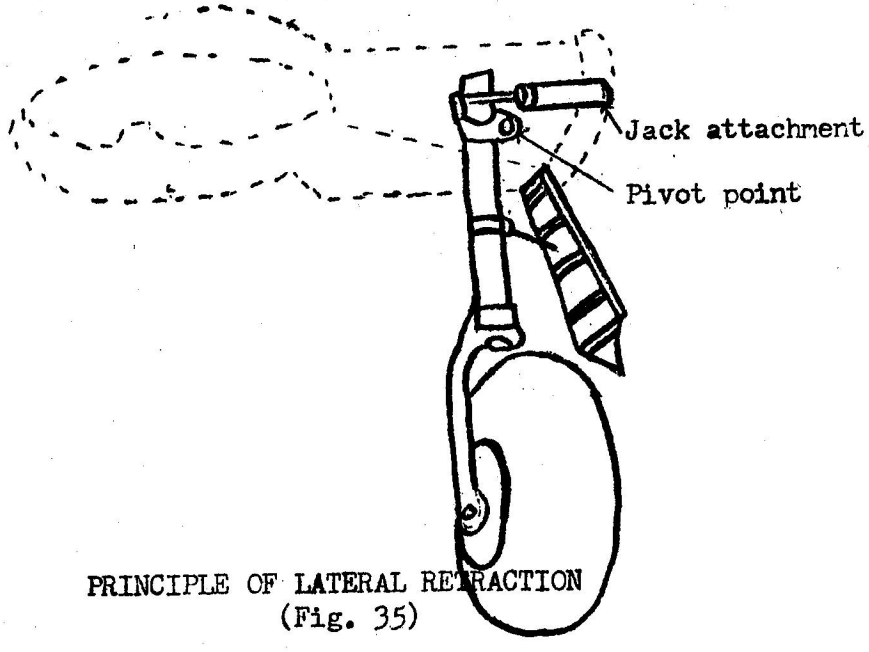
(e) Retractable Undercarriages

At high speeds, exposure of the landing gear creates a considerable loss of power by its resistance of drag. This resistance has been eliminated by use of the retracable landing gear which is drawn up in the nacelles in the wings or into recesses inthe sides or bottom of the fuselage. On some aircraft part of the landing gear remains exposed while others the gear is completely retracted. The gear folds backward, forward, or in either lateral position depending on the aircraft's construction. (See Fig. 35)

Retraction of the landing gear is accomplished by one of three means; manual, electric, or hydraulic. Usually manual control is provided along with electric or hydraulic operation as a safety precaution. An indicator is provided to show the position of the gear "up" or "down". Locks which are controllable from the cockpit or automatically hydraulically operated, lock the gear in the "down" or "up" position.



CANTILEVER UNDERCARRIAGE (Fig. 34)



PRINCIPLE OF LATERAL RETRACTION
(Fig. 35)

Warning signals are generally used in conjunction with the retracting mechanism. Signals usually consist of an electric horn or a red warning light mounted in a conspicuous position in the cockpit. These warning devices are wired to the engine throttle in such a manner that, if the landing gear is not fully extended and locked, the warning signal will operate when the throttle is pulled back to idling.

(f) Tricycle Undercarriage

The conventional type of undercarriage is that of the two main wheels mounted forward of the centre of gravity. Supplemented by by a tail wheel mounted at the rear of the fuselage. This has been satisfactory but has two weakensses; the position of the aircraft on the ground restricts the pilot's vision, and the possibility of "nosing over" when landing. The modern tendency of high speed aircraft makes a high landing speed relatively unavoidable, and because of this, the TRICYCLE undercarriage is becoming increasingly popular. On this type themain wheels are BEHIND the centre of gravity and the third wheel mounted under the nose (nose-wheel). This is an ideal arrangement to prevent nosing over when applying a sever braking when landing at high speed on a comparatively short runway and the pilot's vision is also improved. Thirdly, the aircraft is landed more easily in a tail-up attitude, a great advantage on high speed aircraft.

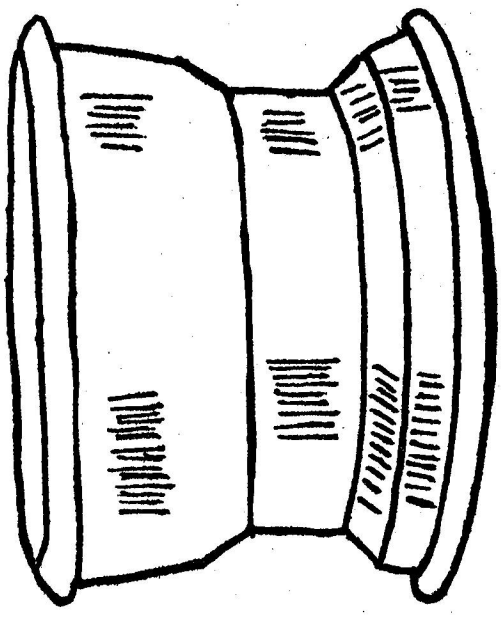
Wheels

Modern wheels are usually cast from aluminum or magnesium alloys and may be roughly difided in to three classes, according to the provision for mounting the tire:

(a) Drop centre
(b) Detachable flange (or rim)
(c) Split or two piece.

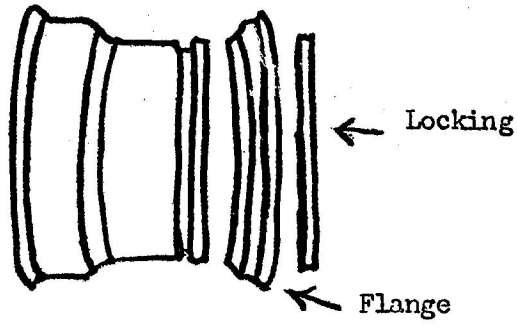
Drop Centre Wheels

The drop centered wheel is cast with the flange integral, and the tires are mounted by first searing one bead of the tire in the well, placing the inner tube in the tire and then prying the other tire bead over the appropriate flange; the same as mounting a tire on a modern automobile wheel. The rim and hub are connected by heavy spokes (cast integral) usually of "u" or "T" cross-section. Sometimes fins are cast integral with the under side of the well between the webs of spokes, to dissipate heat resulting from severe braking. The outer face of the wheel sometimes has hollows also for heat dissipation. A steel brake drum is pressed into a recess on the inside of thw wheel, further secured by rivets or set screws. At wither end of the axle bore is



Drop Centre

Removeable Flange - A separate casting which is removeable.



Split Wheel - Two halves held together with bolts or studs

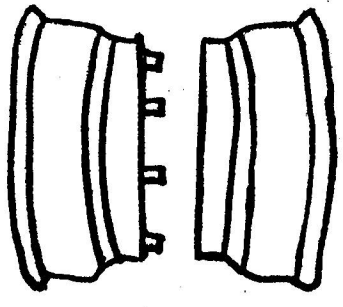


Fig 37

a recess to accommodate roller or ball bearings. A common feature on divided undercarriages using a single cantilever leg is a tapered wheel axle with accommodation for a heavy tapered roller bearing on the inner end and a lighter bearing on the outer end. (See Fig. 36)

Detachable Flange Wheel

Mounting of tires on wheeld that have a small diameter compared to the outside diameter of the tire, is difficult. A wheel with a detachable rim simplifies the tire mounting. The construction of this type is similar to the drop well type except that one flange is not integral with, and can be removed from the hub. The demountable flange is usually retained on the wheel rim, by a locking ring (large circlip) which seats in circumferential grooves in the flange and wheel rim. Side pressure of the inflated tire, holds the flange against the locking ring, locking the inflated tire, holds the flange against the locking ring, locking the latter in position. The flange is removed by deflating the tire, prying the flange away from the locking ring, and removing the locking ring. (See fig. 37)

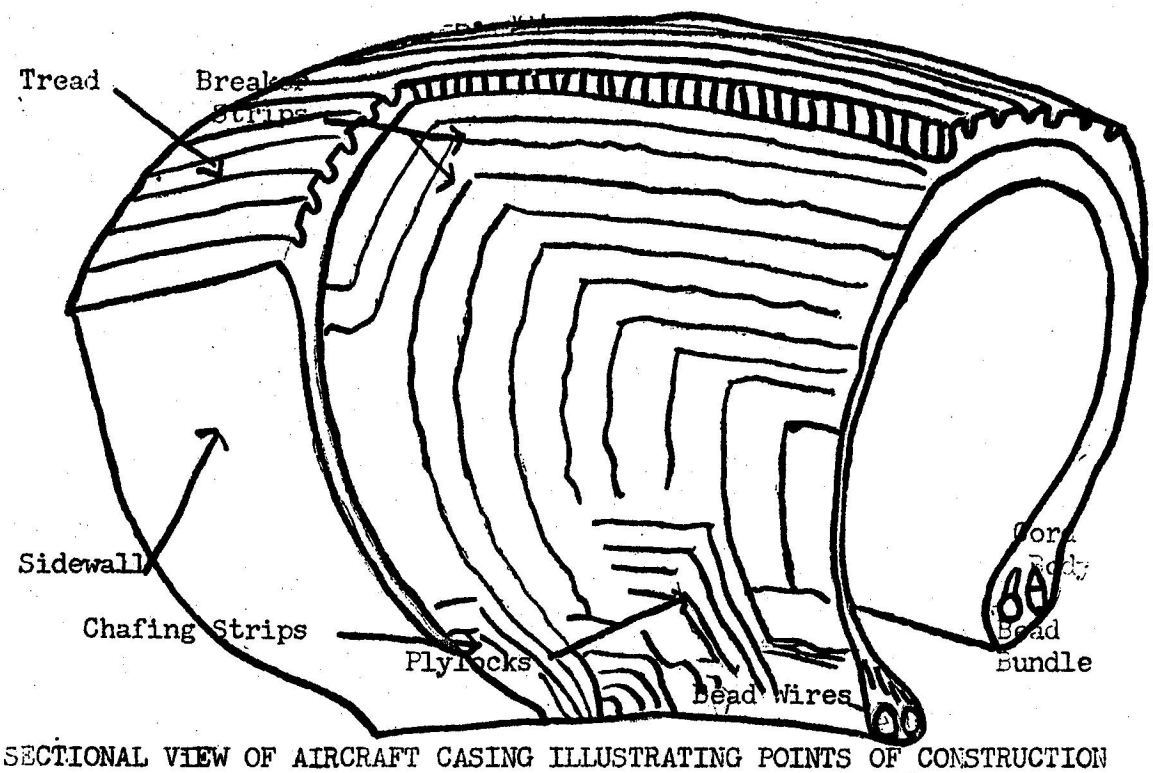
Split Wheel

Another wheel type that simplifies tire removal and replacement is the split wheel; this is commonly used on very large wheels. The wheel is constructed in two halves, the dividing plane being 90 degrees to the axle bore, and each half is an individual unit having a web in the center of the complete wheel. The two halves are joined by means of nuts and bolts through central webs. Great care must be observed when separating these halves in that the tire must be COMPLETELY deflated first.

Tires

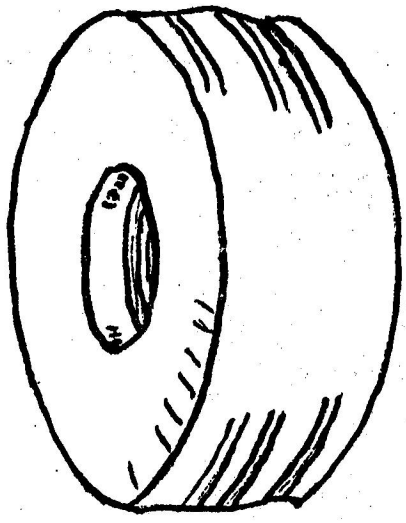
Tires are designed to "cushion" the aircraft during take-off, landing, taxiing, or even standing in a wind. The tire must be sturdy enough to support the aircraft on soft surfaces efficiently, but at the same time, because a tire is part of the undesirable weight of the undercarriage, it must be constructed as light as possible. Modern aircraft with high landing speeds demand a very high performance due to the "skid" which occurs before the inertia of the wheel is overcome when the tire first touches the ground on landing.

The "Carcase" of the tires is built up of cotton cord fabric plies (usually 8 to 12) or recently, on very high performance tires of nylon fabric. The plies are of "warp" thread only to prevent chafing with "weft" threads when the tire flexes. These are bonded together with rubber film. Outside of these inner plies are "BREAKER STRIPS" which are one or two strips of spaced cords much heavier than those used on the inner plies. The breaker strips are to be distribute impact shocks



SECTIONAL VIEW OF AIRCRAFT CASING ILLUSTRATING POINTS OF CONSTRUCTION
Fig. 38

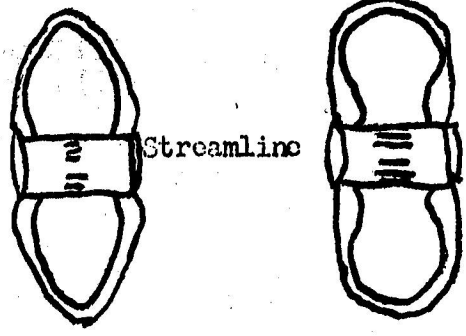
Fig. 39



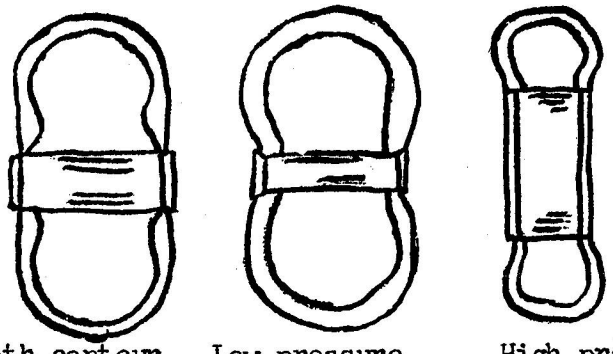
Low profile
Channel tread
Casing

Pointed tread - contour

Rounded tread - contour



Streamline



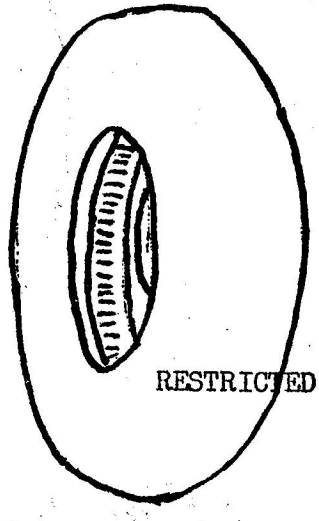
Smooth contour

Low pressure

High pressure

Types of Tread

A Smooth Tread
(i) Tread surface or face of tire is smooth.

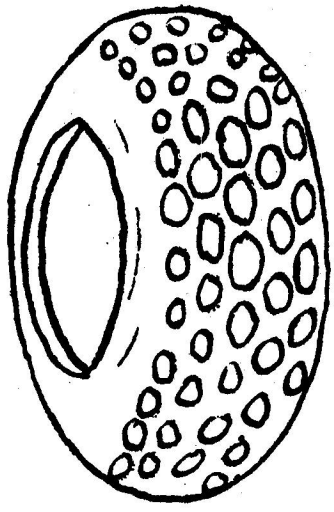


RESTRICTED

Fig. 40

B Button tread

(i) Raised button shaped lugs on face of tire
(ii) A non skid tread



C Ribbed tread

(i) Grooves running around face of tire.

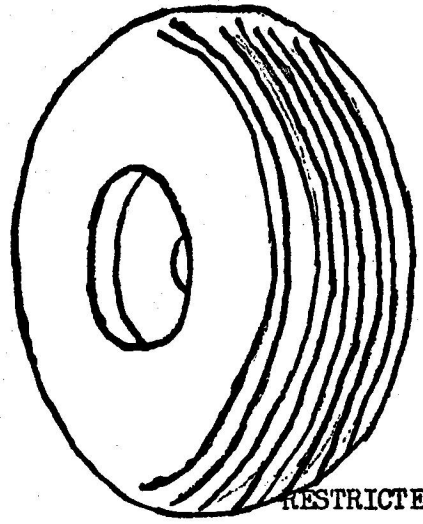


Fig. 41

and strengthen the tire. Many tires have a layer of white rubber over the breaker strips at the tire thread, known as "wear indicator strip" to warn an observer of the degree of war. Surrounding this structure is a layer of rubber, thicker at the thread than on the side walls which protects the strength-giving fabric piles from damage and wear and atmospheric conditions especially water. The outer rubber is compounded with CARBON BLACK to increase wear resistance. The inner edges of the tire, known as the BEAD are ehld to shape and size by coils of high tensile wire, moulded into the tire during construction. The bead seats behind the wheel flanges, when the tire is mounted on the wheel, which retains the tire on the wheel. The wire beads are first wrapped in fabric or rubber further secured by strips of strong canvas, called FILLERS, the edges of which are secured between the edges of the fabric innerplies. The outside of the bead, is protected by CHAFFERS of canvas to reduce wear by the wheel rim.

Type of Tires

Low Pressure

(a) 10 to 30 lbs.
(b) Used on very light aircraft.

Smooth Contour

(a) Side of tire and rim of wheel forms smooth flush surface
(b) Tread can be ribbed, non skid, smooth

High Pressure

(a) 30 - 160 lbs.
(b) Used on most service and commercial aircraft.

Rounded Contour

(a) Side of tire and rim of wheel forms smooth flush surface
(b) Tread of tire will be smooth tread.

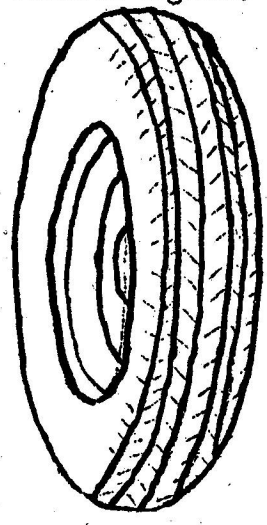
Low Profile

(a) Diameter of inflated tire and wheel designed to mimimum difference.
(b) Provides safety factor on some nose wheel installations.

Pointed or streamline contour

(a) Tire comes to point or streamline shape at tread.

D Allover non skid tread
(i) Grooves cut in face of tire at various angles.



E Channel tread
(i) Face of tire is flat.
(ii) Grooves running around face of tire.

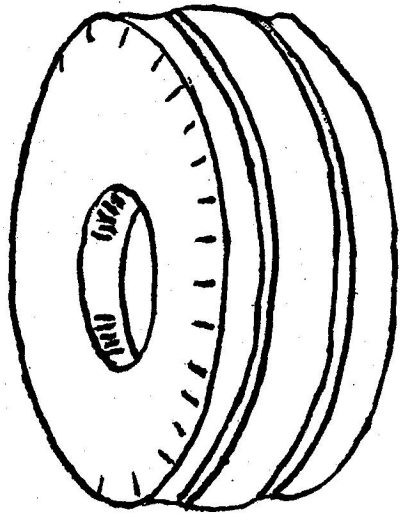


Fig. 42

Types of Tread

Smooth Tread

(a) Tread surface or face of tire is smooth.

Batton Tread

(a) Raised botton shaped lugs on face of tire
(b) Non skid tread

Ribbed Tread

(a) Grroves running around face of tire

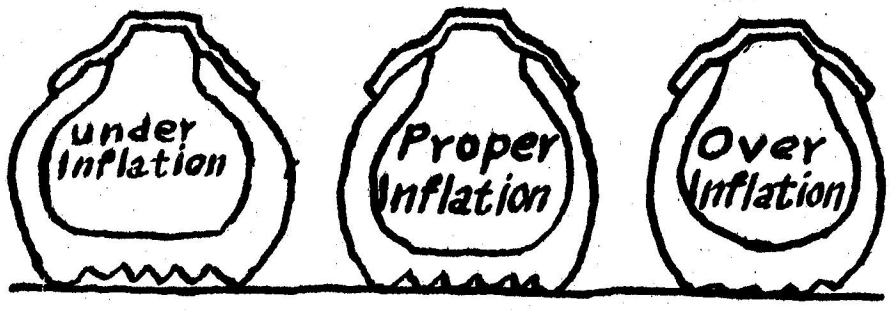
All over Non Kid Tread

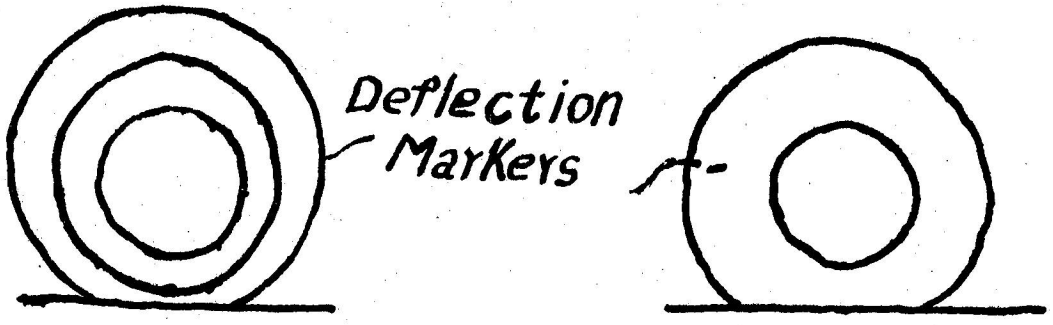
(a) Grooves cut in face of tire at various angles.

Channel Tread

(a) Face of tire is flat
(b) Grooves running and face of tire.

Tire Inflation





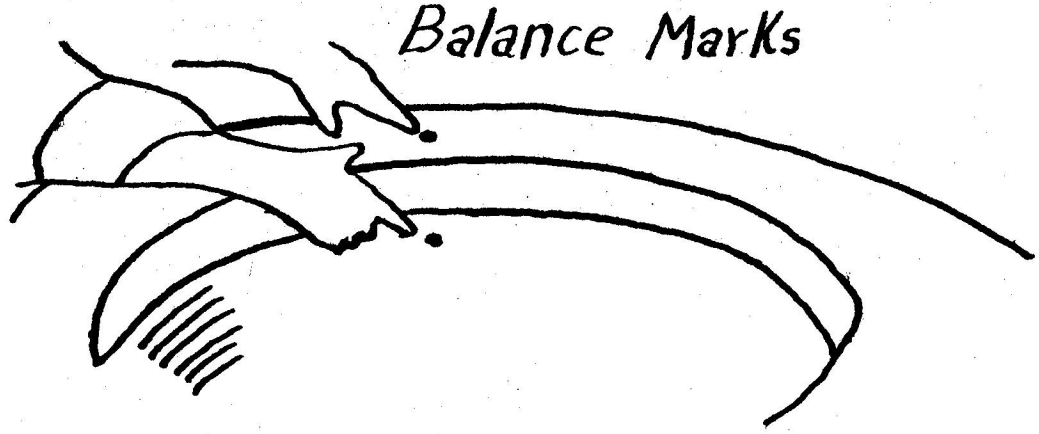


Fig 43

Tire Defects

Cuts

(a) Appear in the tread or sidewall of tire
(b) Tires with cuts which expose or penetrate the cord body below the breaker strip must be removed.
(c) Tire with minor scratches or cuts which do not penetrate the cord body do not have to be removed.
(d) Cuts that are deep, running through more than 50% of the remaining tread and are over 2 inches in length are to be repaired.

Ozone Cracking

(a) Checking which appears mainly on the sidewall of tire and appears as fine hairline cracks in surface of rubber.
(b) Caused by exposure to the elements, particularly sunlight
(c) Does not impair or reduce tire serviceability in most cases as it seldom extends below the outer surface.

Loose Cords

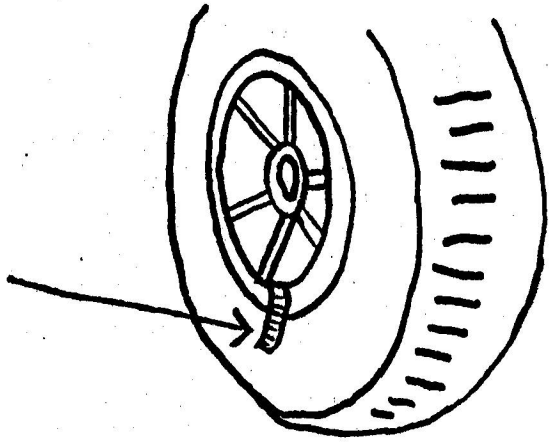
(a) Cords on the inside of tire are dislodged or separated from the carcass
(b) Caused by tire being run flat or extremely soft.

Damaged to Bead Key

(a) The bead key, which is common to Dunlop aircraft casings only.
(b) Bead key is torn or severed from the bead.
(c) Caused due to improper mounting or centering, or damage at the time of mounting.
(d) These projections must be fitted properly and care must be exercised to prevent their destruction.

Brake Burns

(a) Small braking surface and constant application of brakes generates heat.
(b) Temperature may be great enough to melt bead and leave a stickly residue with no strength or binding quality, through which the bead wires may be exposed.
(c) Generally occurs in the region below the rim flange and may be hidden by flange.



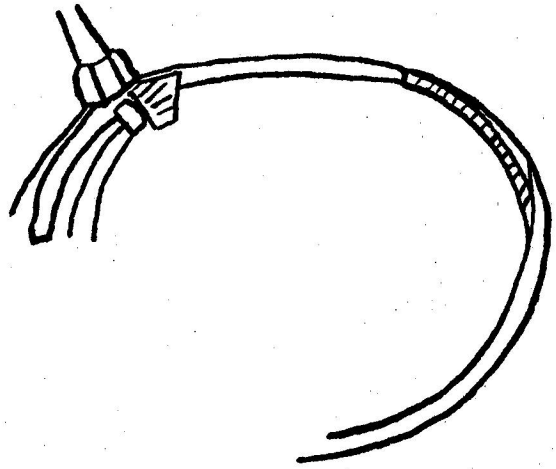


Fig. 44

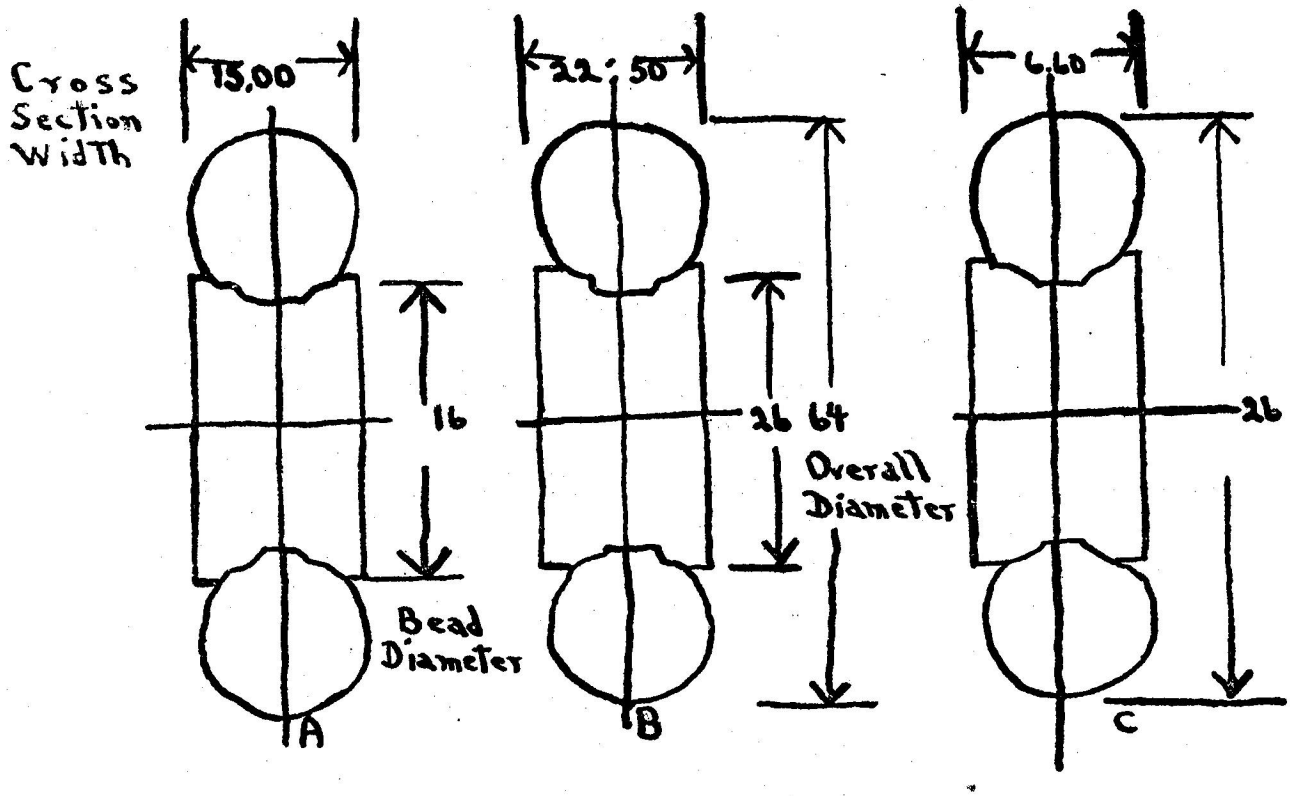

Cross Section Width
15.00
22.50
6.60
16
26.64
Overall Diameter
26
Bead Diameter
A
B
C

Fig. 45

Skid Burns

(a) Caused by friction of tire on the runway
(b) Readily identified since they occur at one position and will leave a flat spot on the tread or wear right through to cord body.

Bead Cracks

(a) Occur at the top edge of the rim flange and appear as if rim had cut into the fabric.
(b) May be caused due to overloading, underinflation, a poor rim conditions or an inherent structural weakness in a particular make or brand or tire.

Tire Inflation

Correct inflation is the most necessary single maintnemace function to be performed, in order to botain long and save serfice from aircraft tires.

Under Inflation

(a) Tire more likely to creep or slip causing valve stem to be cut off. (Maximum amount of creep allowed - 1 inch)

(b) Causes rapid, uneven wear on the edges of the tread.
(c) Severe under-inflation way cause cords to loosen.
(d) Tire may flex over the wheel valve causing damage in wheel area.

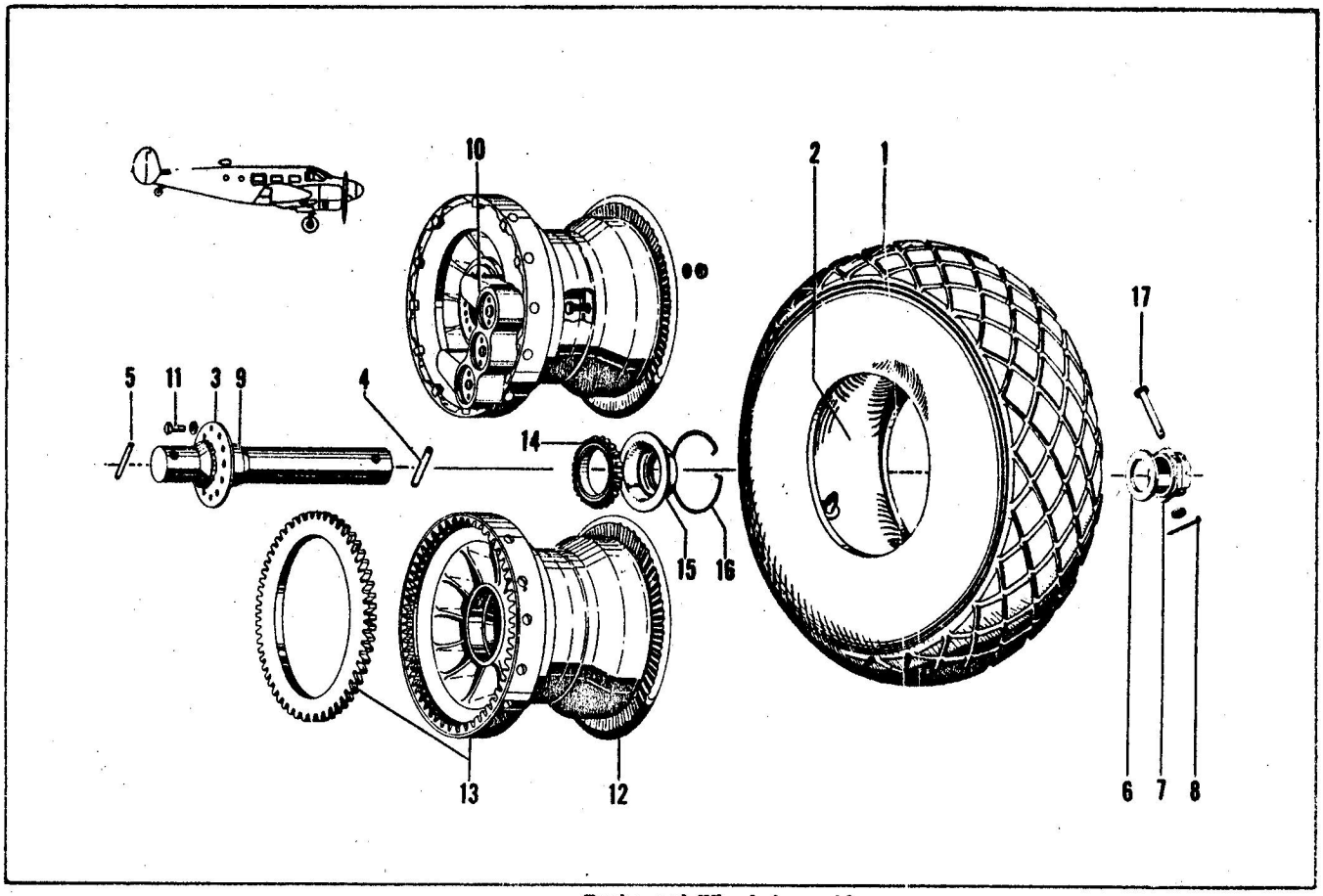
Overinflation

(a) Reduces contact area of the tire on the ground, which results in much faster tread wear in centre of tire.
(b) Causes tension or stain on cords so that there may not be sufficient stretch left to absorbe shock of landing and a rupture of cord body is more likely to occur.
(c) Place extra strain on the landing gear and other parts of aircraft.

Correct Infaltion Methods

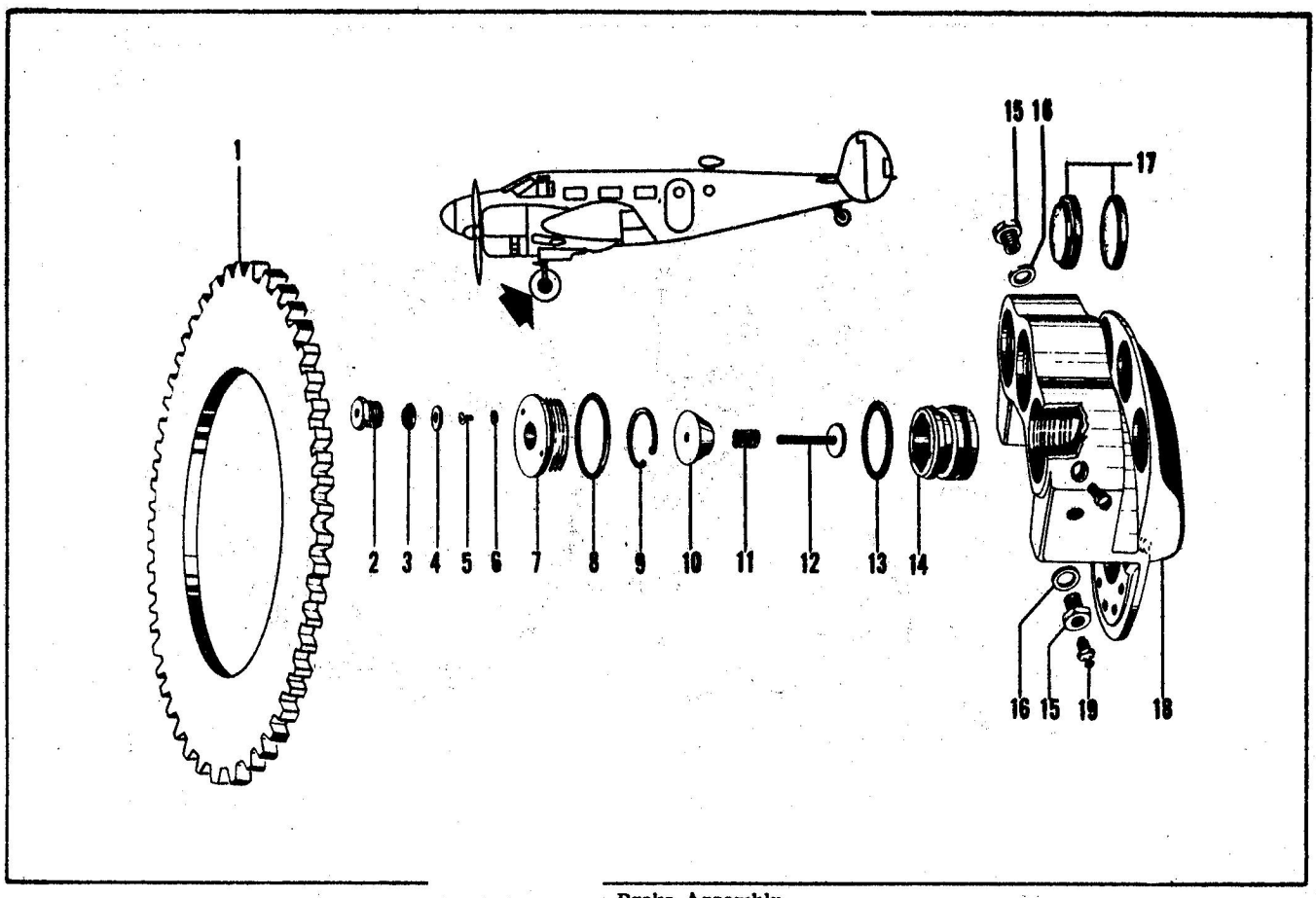
Tire inflation pressure depends on the gross take of weight of the aircraft.

NOTE: A table in EO 110-5-2 gives method of determining correct pressures.



Brake and Wheel Assembly

1 Tire
2 Tube
3 Axle - wheel
4 Pin - landing gear axle torque inboard
5 Pin - landing gear axle torque outboard
6 Washer - wheel bearing
7 Nut - wheel bearing retainer
8 Pin - cotter 3/16 x 3 inch
9 Collar - wheel axle
10 Brake Assembly
11 Bolt - aircraft no 5/16 - 24 x 1 1/8 inch
12 Wheel half assembly - inboard
13 Wheel half Assembly - outboard
14 Bearing - wheel
15 Ring - bearing retaining
16 Ring - retainer lock
17 Pin - flat head 3/16 x 3 5/64 inch



Brake Assembly

1 Disc - rotating brake
2 Nut - packing screw adjustment
3 Wiper - felt
4 Gasket - brake washer
5 Screw - Brake bleeder adjustment
6 Washer - brake bleeder adjustment screw
7 Head - brake cylinder
8 Seal - brake cylinder head
9 Ring - spring plate lock
10 Plate - movable spring return
11 Spring - piston return
12 Pin - piston adjustment
13 Seal - brake piston
14 Piston - brake cylinder
15 Bushing - fluid inlet
16 Washer - fluid inlet bushing
17 Discs - brake lining
18 Housing - brake cylinder
19 Valve - brake bleeder

When inflating a newly mounted assembly, inflate. Deflate and inflate again to remove wrinkles and properly position tube in tire.

A newly mounted tire must be checked daily for several days as air may be trapped between tube and tire. This air will seep out with use causing pressure to drop.

NOTE : Nylon casing are known to stretch on initial inflation. Therefore, they are to be assembled and inflated to correct pressure at least 24 hours prior to installation on aircraft. Casings so mounted are to be stored so they will not rest on rolling surface of the casing which will cause low spots.

Deflection markers and guages

Dashes or ring running around tire. Used as means for determining pressure only in cases of emergency where a guage is not available.

Balance Marks

(a) The balance mark on the tire, which locates the lightweight point is a red dot immediately above the bead of the tire.
(b) The balance mark on the tube which locates the heavy point, is approximately $\frac{1}{2}$ inch wide and 2 inches long.
(c) Balance mark on tubes are to be placed so they are located at the balance mark of the tire.

Creep Marks

Purpose to give a positive visual indication if the tire and tube are slipping on the wheel.

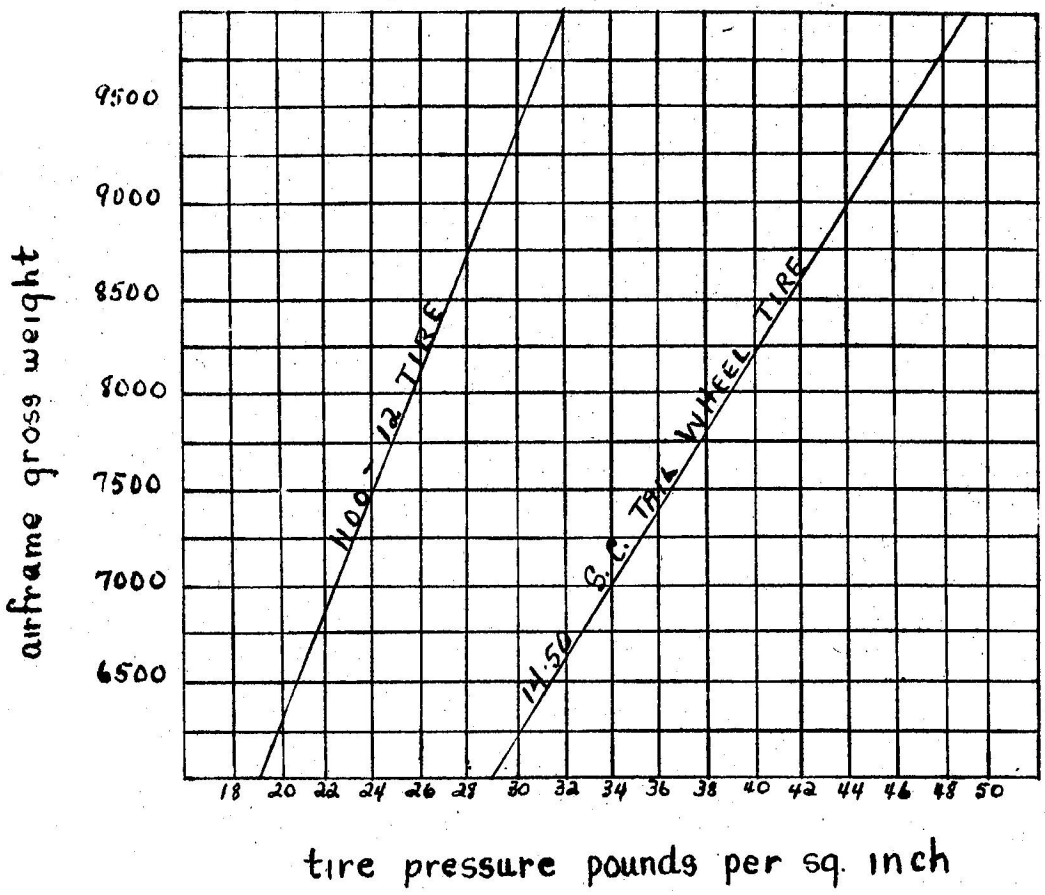
Size a mark 1 inch wide and 2 inches in depth, extending 1 inch on sidewall of tire and 1 inch on the rim of wheel. Painted white in colour using cellulose nitrate paint ref. no 33A-436.

Aircraft Tube Construction

Aircraft tire inner tubes of the smaller sizes are moulded in one piece, but large tubes are built up in visible sections. The rubber compound used has a high flexibility and resistance to heat with a small weight and low degree of porsity.

General aircraft inner tubes consist virtually of one piece of vulcanized rubber with no perceptible weakness at the joint or variation in thickness.

Tubes are fitted with valves in which the stem is attached to a rubber base which is vulcanized to the tube.


airframe gross weight
9500
9000
8500
8000
7500
7000
6500
18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50
tire pressure pounds per sq. inch
H09 - 12 TIRE
14.50 S.C. TRK WHEEL TIRE

Aircraft Tube Construction

The dual seal inner tube consists of an inner tube of two or more plies of rubberized fabric within a heavy rubber tube, both united at the base and filled by means of a valve permitting direct inflation.

(a) Gives great safety factor for blow outs, punctures, or cuts.
(b) When pressure from outer chamber escapes trhough the rupture, causes the inner chamber to expand filling the tire.
(c) This retains necessary air pressure to keep tire seat firmly on rim.

Air blood ridges - ridges moulded around tube to permit blooding of air trapped between inner tube and tire casing. Used on high pressure tubes and some low pressure tubes.

Tire Size Identification

Tire sizes are usually identified by two or three dimension which are in inches, generally written in the following form:

(a) 15.00 - 16
(b) 64 x 22.50 -26
(c) 26 x 6.6

Tube Defects or Failures

Heat thinning caused by inside diameter of tube next to the wheel being subjected to considerable heat from braking action. Flexing of the tire and movement of the bead stretches and chafes this region. Rubber fails and splits around the tube.

Puncture caused by a foreign object penetrating the tire and tube allowing air to escape in a few minutes or several hours.

Valve base leak due to poor adhesion at edge of valve pad. May be cut by valve hole or weakened by oil and grease.

Damaged valves - caused by improper mounting or valve striking an object when rotating. Tire creeping on rim which is caused by underinflation.

Wrinkled - wrong size tube used or a stretched or worn tube used is larger than inside of tire. Can happen to a new tuve when proper size is used but improperly mounted.

Piched - tube got caught or pinched between tire iron and tire or iron and wheel during the mounting operation.

Splice Leaks - all tubes contain a splice or seam which may not knit together. Caused by foreign substances or poor workmanship.

Blow Out - injury is quite extensive and usually rips tube beyond repair. Caused by sudded release or air by a damaged or defective casing allowing air to be liberated explosively.

EXPEDITOR AIRCRAFT - MAIN LANDING GEAR SYSTEM

Description

The main landing gear incorporates an air-oil absorber, equipped with a self compensating rebound control mechanism. The lower or piston portion of the shock absorber carried the wheel in a yoke type strut. The upper or cylinder portion is mounted in a V-brace, which is pivoted on bolts running through bushings in the centre section truss. The oleo drag leg, which dampens shock loads imposed on the gear and centre section truss, connects the shock absorber to the slide assembly, operating on a slide tube running forward and upward in the nacelle.

The retracting chain driven by the landing gear motor through a system of gears and torque shafts, moves the slide along the slide tube drawing the gear backwards and upward inot the nacelle. Thelanding gear motor is controlled by a switch on the pilots control pedestal, and a dynamic braking relay. Limit switches in the left nacelle actuated by the slide assembly control travel of the gear in both directions. Similar switches in the right nacelle control position lights on the pilots control pedestal, indicating position of the gear. Safety switches in the landing gear control and position switch latch circuits prevent accidental retraction while the weight of the aircraft is on the gear. Landing gear doors are automatically operated by actuating links between the shock absorber and the doors.

Wheels, Tires and Tubes

Each main landing gear has a 12 inch balanced split wheel, the halves held together by 12 bolts and nuts. Each half is balanced indepandtly of the other and for maintenance purposes may be repalced separately. On the outboard half, and extended flange with hardened steel drive keys matches the slots in the brake disc. Beginning with Expeditor 3 series aircraft, serial CA220 through CA265 and CA 276 and after except CA281, the extended flange have gear rings instead of drive keys and the brake discs have matching gear teeth which mesh with those on the flanges. Wheels are supported on tapered roller bearings seated in hardened steel cones.

Tires and Tubes

Tire size - 14.15 smooth contour tires - tail wheel
Tire size - 11.00-12, 8 ply - MLG
Tube size - 11.00-12 regular tubes.

Themain wheel tire inflation is given by the 11.00-12 tire line. The tail wheel tire inflation pressure is given by 14.50 smooth contour tire line. If a guage is not abailable inflate the tires so the distance from the ground to the centre line of the axle is $12\frac{3}{4}$ inches for the main wheels, and 6 inches for the tail wheel.

LANDING GEAR SHOCK ABSORBER ASSEMBLY

1 Knee Assembly - landing gear torque

2 Pin - landing gear torque knee

5 Lubricator - torque knee

6 Lubricator - torque knee

7 Bushing - torque knee

8 Bushing - torque knee

9 Knee - landing gea torque

10 Bushing

11 Piston and Fork Assembly - landing gear LH and RH

13 Cap - landing gear

14 Cap - landing gear

15 Stud - landing gear axle bearing cap inboard

16 Stud - landing gear axle bearing cap outboard

17 Stop - landing gear extension

19 Packing

20 Seal - landing gear fork assembly

21 Ring - landing gear fork seal retainer

22 Gasket

23 Cap Assembly

25 Valve Assembly

26 Cylinder Assembly - landing gear shock absorber

27 Control Assembly - landing gear rebound

28 Cylinder Assembly - landing gear inner

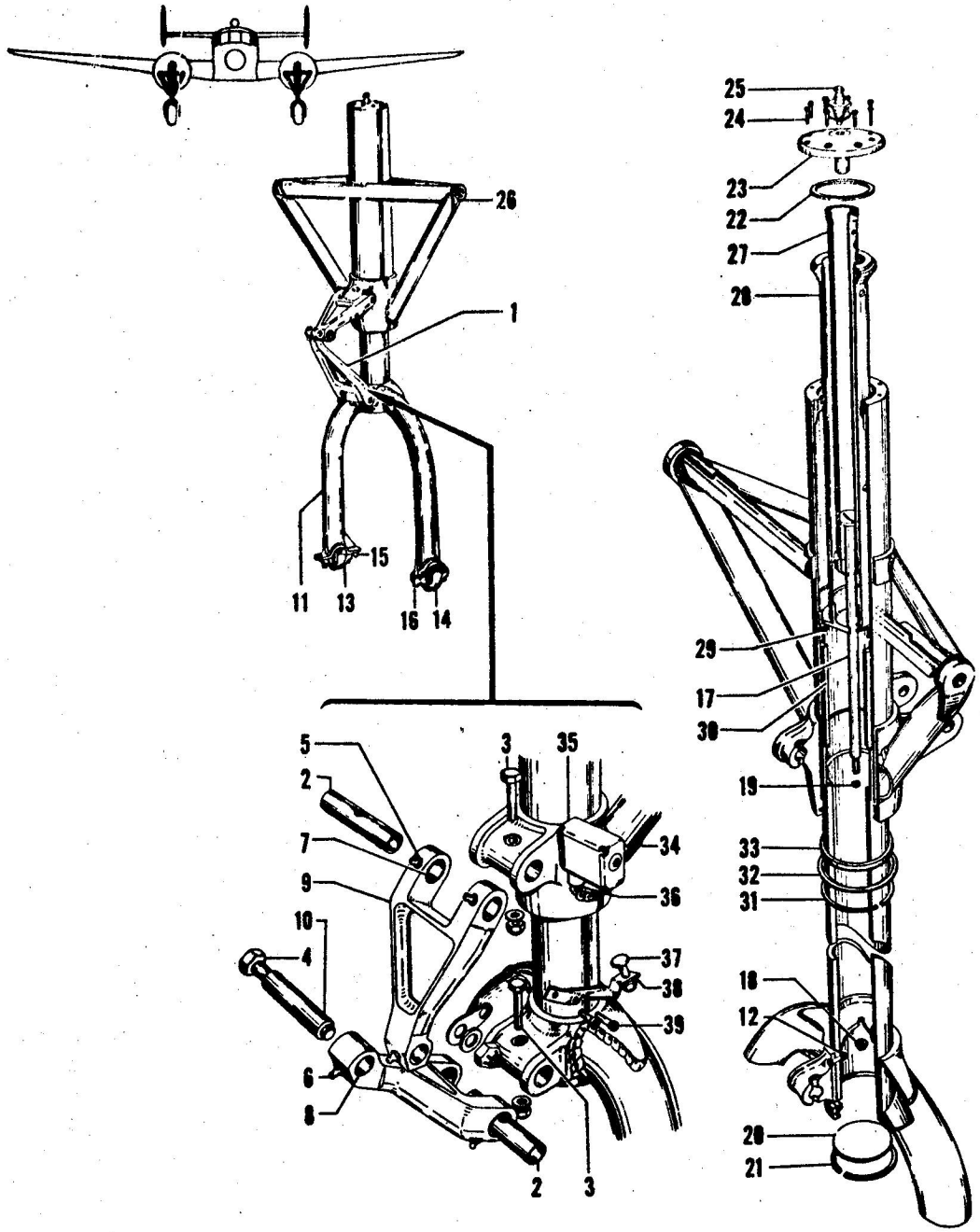
34 Bracket Assembly - landing gear safety switch LH and RH

35 Cover - landing gear safety switch LH and RH

36 Switch - landing gear safety LH and RH

37 Bolt - landing gear safety switch actuator

38 Actuator Assembly - landing gear safety switch LH and RH



Landing Gear Shock Absorber Assembly

Shock Absorber Assembly

The main landing gear shock absorber is equipped with a self compensating rebound control mechanism. It consists of a cylinder mounted in a V-brace pivoted to the centre section truss, and a piston which carries the wheel in a yoke type strut. Torque knees, interconnecting the cylinder and piston, hold the main wheels in alignment.

Servicing

Fill landing gear shock strut with hydraulic fluid, specification 3-GP-26A as follows:

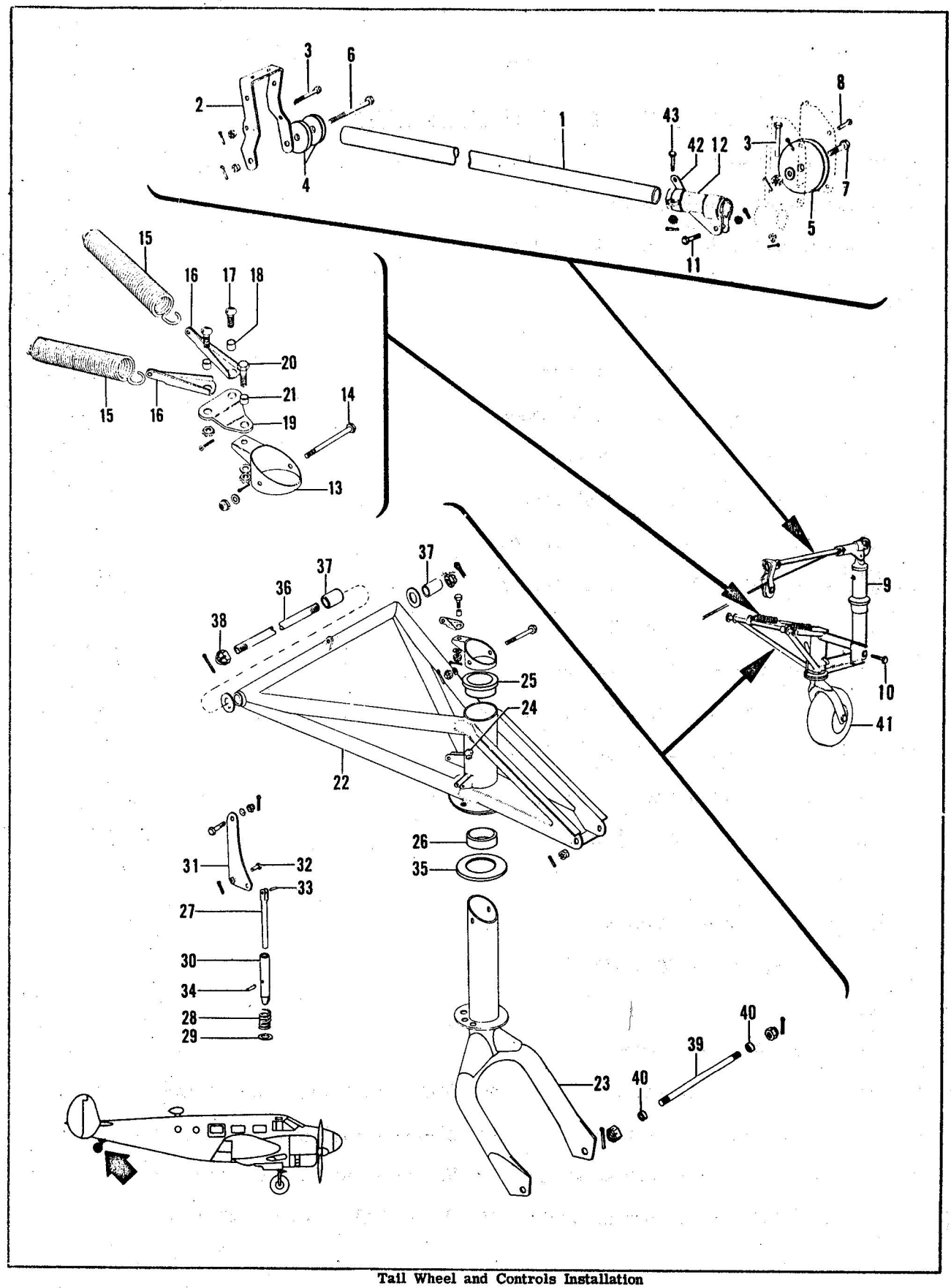
(a) Jack aircraft so that main landing gear is off the floor.
(b) Release air from strut by loosening filler plug on top of strut.
(c) Remove filler plug, compress strut so that only $\frac{3}{4}$ inch of the piston is exposed. A $\frac{3}{4}$ inch block may be placed between the torque knees to obtain this setting.
(d) Fill compressed strut to overflowing with hydraulic fluid, remove block and compress strut.
(e) Replace the filler plug loosely. Extend and compress strut a few times to remove surplus hydraulic fluid.
(f) Tighten filler plug securely and inflate shock struts.

Minor Repairs and Parts Replacement

Carefully inspect all seals; replace any which are worn or cut. Replace the felt cylinder pad if damaged or torn. Repairs which require welding should be made only a designated overhaul activity, since most parts are heat-treated.

Maintenance

The exposed reciprocating parts of shock struts areprone to pick up dirt, dust and grit if an adhesive agent such as oil or preservative compound remains on the surface of such parts. Actuation of parts in this condition will cause scoring and galling of the piston rods, damage to packings, and subsequent leakage and failure. It is necessary, therefore, that the surfaces of such parts be cleaned when actuated. Experience has revealed that a thin film of oil is beneficial to prevent twisting and failure of thepacking due to insufficient lubrication. Before and after each flight, thefollowing precautions shall be complied with. The exposed part of the piston must be thoroughly cleaned of all foreign matter. This will help prevent cutting of seals with resulting leaks and failures. The exposed piston then shall be wiped off with a soft rag moistened in hydraulic fluid, specification 3-GP-26A.



Tail Wheel and Controls Installation

TAIL WHEEL AND CONTROLS INSTALLATION

1 Tube - Tail wheel slide

2 Bracket - Tail wheel boot

3 Bolt - aircraft No 10-32 x 1 5/8 inch

4 Pulley

5 Pulley

6 Bolt - Aircraft $\frac{1}{4}$ - 28 x 4 inches

7 Bolt - aircraft $\frac{1}{4}$ - 28 x 1 1/8 inches

8 Pin - Flat head 1/8 x 21/32 inch

9 Absorber Assembly - Tail wheel shock

10 Bolt - aircraft 5/16 - 24 x $2\frac{3}{4}$ inches

11 Bolt - aircraft 5/16 - 24 x $1\frac{3}{4}$ inches

12 Slide Assembly - Tail wheel

13 Collar Assembly - Tail wheel fork

14 Bolt - Aircraft No 10-32 x 1 9/16 inches

15 Shring - Tail wheel alignment

16 Clip - Tail wheel alignment spring

17 Bolt - clevis 1/4 - 28 x $\frac{1}{2}$ inch

18 Bushing

19 Plate - Tail wheel alignment

20 Bolt - aircraft $\frac{1}{4}$ - 28 x 5/8

21 Bushing

22 Truss Assembly - Tail wheel

23 Fork Assembly - Tail wheel

24 Lubricator - tail wheel fork

25 Bearing - Tail wheel fork assembly

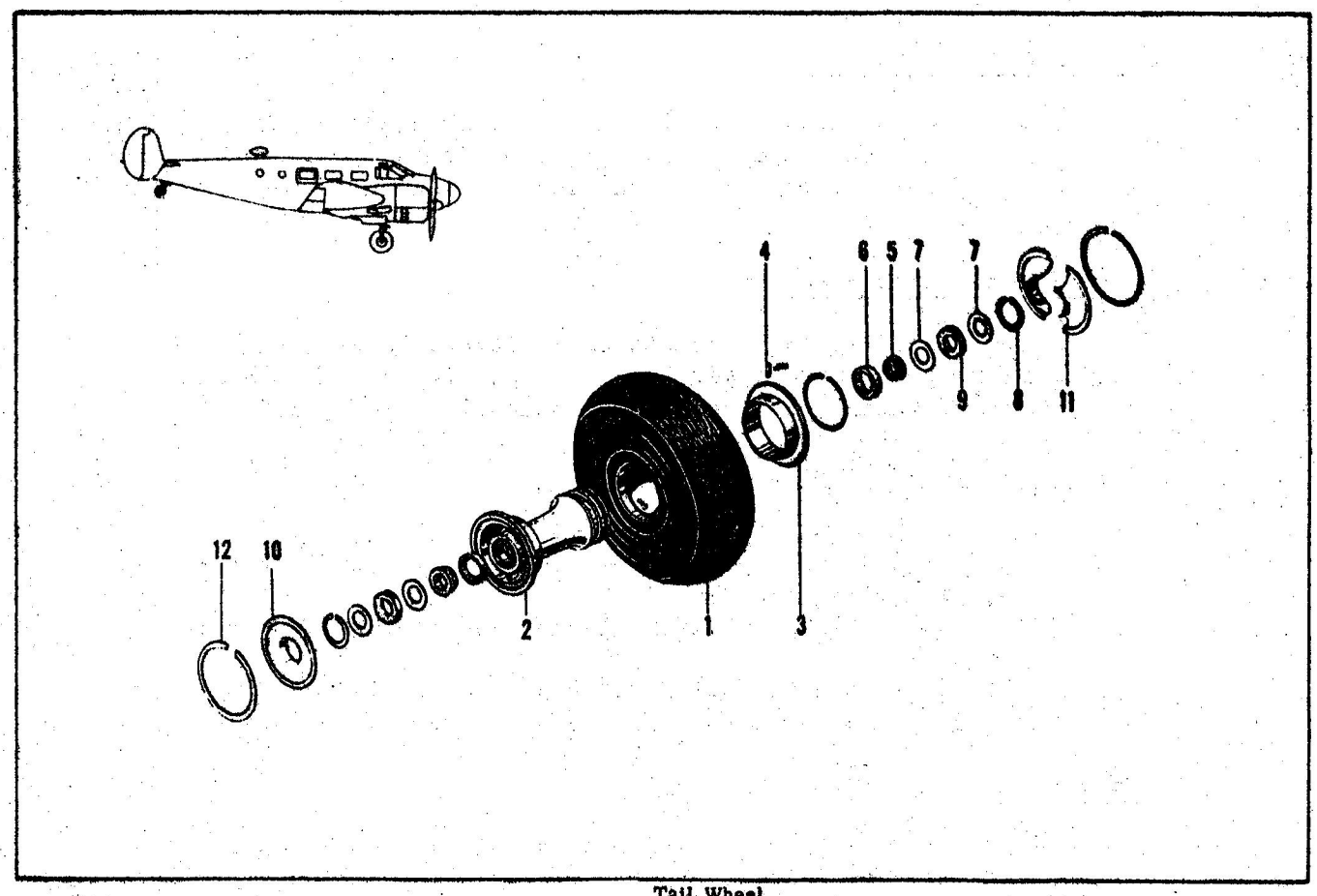
26 Bearing - tail wheel fork assembly

27 Link - tail wheel swivel lock

28 Spring - tail wheel swivel lock

29 Washer - tail wheel swivel lock

30 Pin - Tail wheel swivel lock



Tail Wheel

1 Tire - tail wheel
2 Wheel - tail
3 Ring - tail wheel side
Ring - side ring retaining
4 Pin - side ring anchor
5 Bearing
6 Cup - bearing
7 Ring - felt retainer
8 Ring - felt retainer lock
9 Seal - Felt
10 Cover - dust inner
11 Cover - dust outer
12 Ring-dust cover lock

Shock Strut Inflation

The proper inflation for the main gear shock strut is 2½ inches. The tail wheel shock strut inflation is 3 inches. Measure inflation from the red line on the piston shoulder to the inside edge of the packing nut.

Landing Gear Oleo Drag Leg.

The oleo drag leg consists of a piston, lower housing and coil spring with approximate seals and packing. It is a double acting self contained hydraulic unit, containing both fluid and air.

Minor Repairs and Replacements

(a) Replace all "O" ring seals and packing rings.
(b) Inspect bushings and replace if worn loose or the holes are elongated.
(c) Clean all parts with alcohol and blow dry compressed air.

CAUTION When installin "O" rings be careful not to cut, scratch, or nick them, when sliding over sharp threads, etc.

Servicing Oleo Drag Leg.

(a) Remove air valve and with strut held at an angle of 30 degrees which is approximately the position it is installed on the airplane, fill with hydraulic fluid, specification 3-GP-26A.
(b) Install the air valve, tighten and apply 50 pounds of air pressure to strut.
(c) Lay strut in a horizontal position with the lower drain plug up. Loosen lower drain plug and allow entrapped air to escape. Tighten plug as soon as air is released.

(d) Place strut in position as described above, remove air valve and refill strut.

NOTE An oil control tube is provided in the piston assembly to preclude possibility of overfilling strut if fluid is added with strut held in the proper position

(e) Install air valve, tighten and add 50 pounds of air pressure. This air pressure is used to avoid an air lock in the top of the strut and is not required to extend the strut, which is spring actuated.

NOTE Instructions above are for filling empty struts. If small amount of fluid is required to replace service loss, the strut

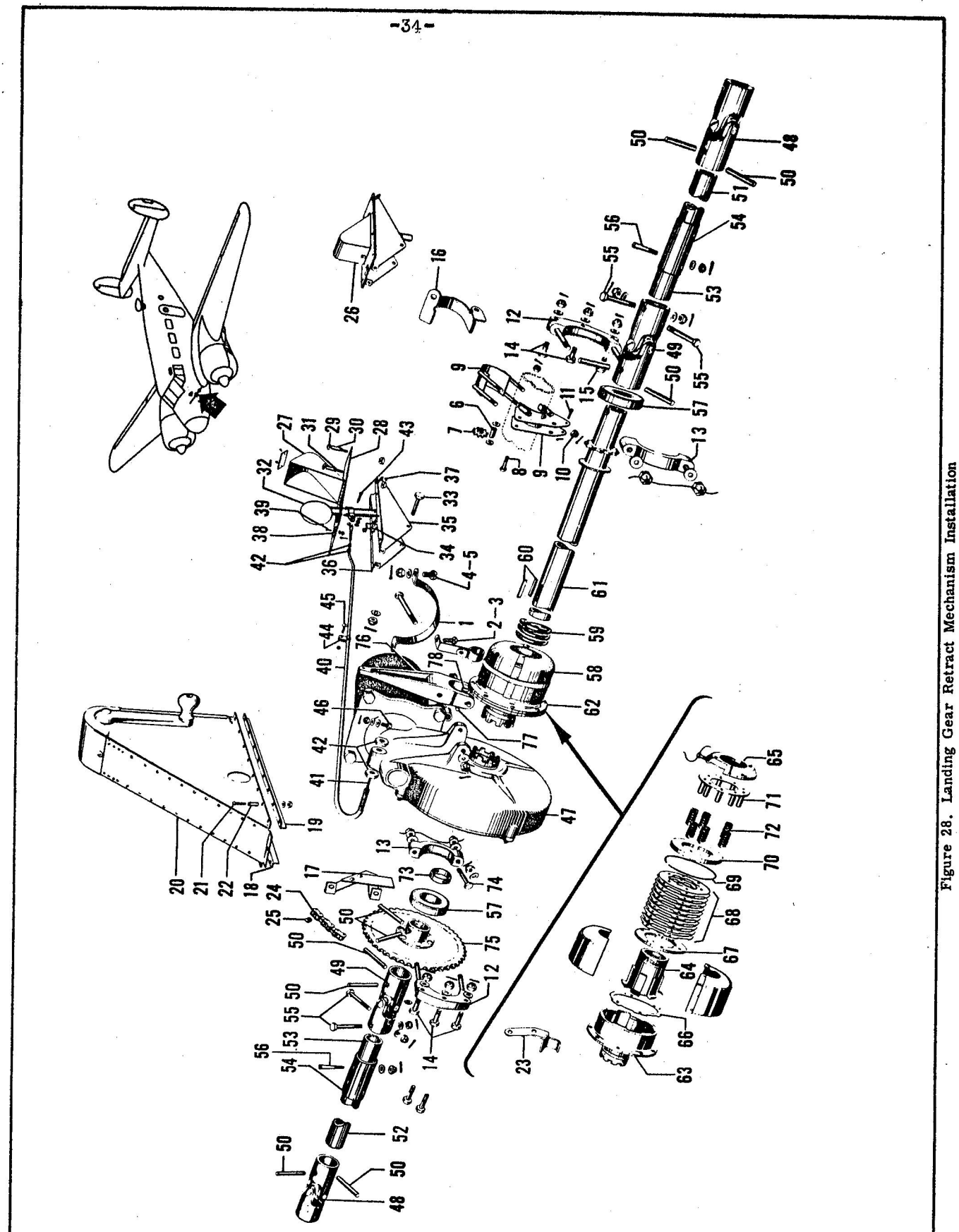


Figure 28. Landing Gear Retract Mechanism Installation

LANDING GEAR RETRACT MECHANISM INSTALLATION

1 Bracket - landing gear motor brush cover
2 Bolt - aircraft 1/4-28 x 5/8 inch
3 Bolt - aircraft 1/4-28 x 3/4 inch
4 Screw - fillister head 8 x 3/8 inch
5 Screw - fillister head 8 x 1/2 inch
6 Bushing - tail wheel retract sprocket
7 Sprocket - tail wheel retract cable
9 Bracket - tail wheel sprocket
12 Housing - bearing landing gear cross shaft
13 Housing - bearing landing gear cross shaft
16 Guard - tail wheel retract chain
17 Guard assembly - hand crank chain
18 Angle - support assembly hand crank LH
19 Angle - support assembly hand crank RH
20 Support assembly - landing gear and flap hand crank
23 Guard - landing gear retracting chain.
24 Chain - landing gear retract hand crank
26 Release assembly - clutch
27 Cover - clutch release
28 Plate - clutch release
30 Bushing
32 Pedal Assembly - clutch release
34 Spring - clutch release pedal
35 Bracket - pedal clutch release
36 Bracket - pedal clutch release
38 Strike - clutch release pedal cover
40 Housing - clutch release cable
41 Cable assembly - clutch release
47 Motor Assembly - landing gear retract mechanism
48 Universal - cross shaft outboard
49 Universal - cross shaft inboard
50 Bar - 1/4 x 3/8 inch
51 Tube - landing gear shaft RH
52 Tube - landing gear shaft LH
53 Tube - landing gear shaft
54 Coupling - landing gear shaft
57 Bearing - landing gear cross shaft
58 Cover - landing gear clutch
59 Spring - landing gear clutch
60 Key - landing gear clutch
61 Shaft - cross
62 Clutch - landing gear retract mechanism
63 Housing - landing gear clutch
64 Hub - landing gear clutch
65 Nut - adjustment
66 Spacer - landing gear clutch
67 Washer - packing
68 Packs - clutch
69 Ring - lock
70 Spacer - landing gear clutch
71 Ring - landing gear clutch
72 Spring - landing gear clutch
73 Collar - cross shaft

may be refilled on the airplane. Remove the air valve and fill to top of filler opening with hydraulic fluid. Reinstall air valve, tighten and apply 50 pounds air pressure.

Tail - Gear System

Description

Tail gear assembly is composed of a welded steel tubing truss, a full swivel fork and an air-oil shock absorber. At its forward end of the truss is hinged to the fuselage. The shock absorber connects the aft end of the truss to the slide assembly for retraction purposes. A locking mechanism controlled from the pilot's compartment locks the swivel fork in a stationary position for take off and landing.

Wheel, Tire and Tube

The wheel assembly consists of a split hub assembly mounting a 14.50 smooth tire and tube. It is supported on the axle by the tapered roller bearings.

The tail wheel tire inflation pressure is given by 14.50 smooth contour tire line using chart. If a gauge is not available, inflate the tires so the distance from the ground to the canterline of the axle is six inches for the tail wheel.

TAIL GEAR TRUSS ASSEMBLY

General

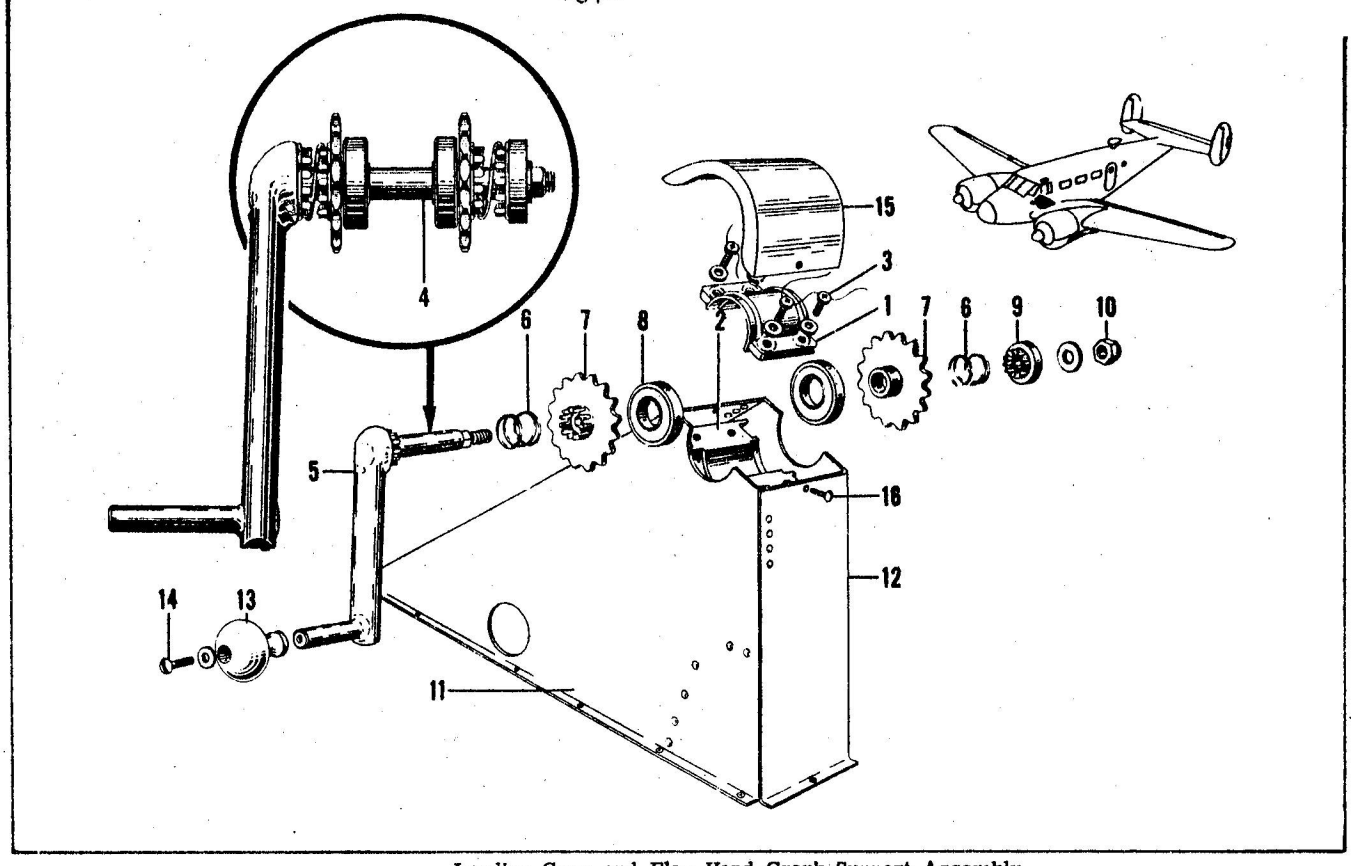
The tail gear truss assembly is welded steel tube structure. It supports the swivel fork and wheel assembly. At its forward end is is hinged to the fuselage, and it is supported on the aft end by an air-oil shock absorber.

Minor Repairs and Parts Replacement

(a) Replace O-ring seals when leaking around packing nut is apparent.

NOTE Tightening of the packing nut will not stop a leak caused by the O-ring packing.

(b) Replace upper and lower bushings if they are worn or appear elongated.
(c) Replace valve core in piston filler plug.
(d) Replace filler plug gasket.
(e) Replace grease fittings in piston and cylinder if they are dented, bent or clogged with dirt.



Landing Gear and Flap Hand Crank Support Assembly

1 Cap - landing gear crank housing assembly
2 Base - landing gear crank housing assembly
3 Screw - fillister head no 10/32 x 5/8 inch
4 Crank assembly - landing gear and flap support
5 Handle assembly - landing gear and flap crank
6 Spring - landing gear and crank assembly
7 Sprocket - landing gear and crank assembly
8 Bearing - landing gear hand crank assembly
9 Sprocket - landing gear crank assembly
10 Nut - self locking 5/16 - 24
11 Support - hand crank
12 Support - hand crank
13 Knob - hand crank
14 Screw - truss head no 8-32 x 5/8 inch
15 Cap - hand crank support
16 Screw - round head no 8/32 x 5/16 inch

TAIL WHEEL LOCK AND LOCK CONTROLS

The tail wheel lock consists of a spring loaded plunger, which locks the tail wheel in a straight position parallel to the lateral axis of the aircraft. The lock control is located on the pedestal and overcomes the spring tension through a cable linkage to unlock the tail wheel.

Minor Repairs and Parts Replacement

Minor repairs will consist of replacing rusted or corroded cables and replacing the spring assembly if it becomes weak. If the housing in the belly is bent or kinked to such an extent that it restricts the operation of the control, it should be replaced. Pullys which are frozen or sticky in operation.

ADJUSTMENTS

The tail wheel lock cable should have enough tension to keep it from dragging on bulkheads and should be kept clean for free and easy movement. The cable should be short enough to withdraw the locking pin completely, but long enough to permit the pin to seat firmly. Cable length may be adjusted with the turnbuckle under the centre aisle floorboards.

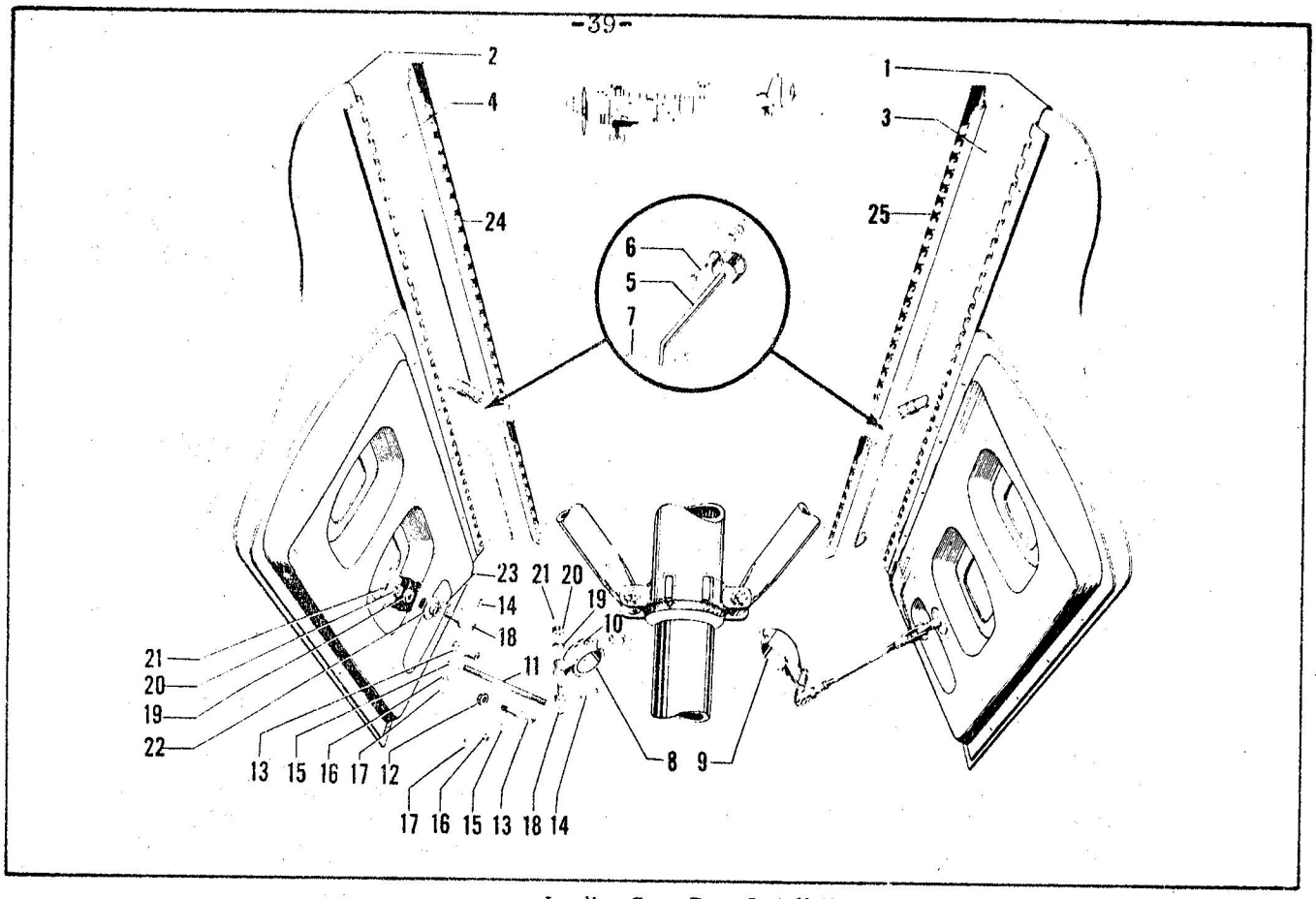
LANDING GEAR RETRACT SYSTEM

Description

The landing gear retracting system is electrically driven and is equipped for emergency manual operation. Torque shafts connect an electric motor and worm gear assembly to chain-driven slides in each of the main wheel wells. The tail wheel retraction slide is operated by cables connected to a chain drive on the motor assembly. A spring-loaded disc-type clutch is installed in the motor drive unit to protect the system against an overload and absorb the shock of starting and stopping. A manual clutch, operated from the pilot's compartment, disengages the motor and gearbox from the system for manual operation.

Main Landing Gear Doors

The main landing gear doors are of heat treated aluminum alloy skin which is riveted and spot welded to a die-formed, reinforced stiffner, holding the skin in the proper conforming contour to match the contour of the nacelle. The doors are attached to the aircraft by a hinge, one-half of which is riveted to the lower portion of the nacelle, while its matching half is riveted to the door. A stainless steel hinge wire, inserted through the matching hinge lugs, attaches



Landing Gear Door Installation

1 Door assembly LH
2 Door assembly RH
3 Pin - hinge inboard
4 Pin - hinge outboard
5 Brace assembly - nacelle door
6 Bolt - aircraft no 10-32 x 1 inch
7 Screw - Truss head no 6-32 x 3/8 inch
8 Socket Assembly - landing gear door link
9 Socket assembly - landing gear door link
10 Bolt - aircraft no $\frac{1}{4}$ - 28 x 1 inch
11 Rod - nacelle door link
12 Nut - check $\frac{1}{4}$ - 28
13 Clevis - rod end adjustment $\frac{1}{4}$ - 28
14 Bolt - clevis $\frac{1}{4}$ - 28 x 27/32 inch
15 Washer - Plain $\frac{1}{4}$ inch
16 Nut - castle shear $\frac{1}{4}$ - 28
17 Pin - cotter 1/16 x $\frac{1}{2}$ inch
18 Eye - swivel base
19 Washer - plain no 10
20 Nut - castellated no 10/32
21 Pin - cotter 1/16 x $\frac{1}{2}$ inch
22 Base - landing gear door swivel
23 Screw - round head no 8 - 32 x $\frac{1}{2}$ inch
24 Hinge - landing gear door
25 Hinge - landing gear door

the door to the nacelle. When the landing gear is retracted the doors cover the wheel well openings. The doors should operate freely and fit snugly enough to avoid excessive vibration. Actuating rods, secured to the main gear assembly, automatically close the doors when the gear for manual operation.

Minor Repairs and Parts Replacement

Inspect the door for spot welds which have broken loose. Repair by adding a rivet on each side of the broken spot weld. Small cracks, not over $\frac{1}{2}$ to $\frac{3}{4}$ inch in length, may be stop drilled. Distorted doors must be replaced. Inspect the swivels for excessive play and/or restricted movement. Swivels which are sticky in operation or those which have excessive play should be repalced.

Rigging Main Landing Gear Doors

The landing gear doors are adjusted by varying length of the actuating rods which connect the doors to the shock strut and by moving the clamp up or down or rotating it on the V-brace. Properly adjusted, the doors will fit smugly with about 1/8 inch clearance between them when fully retracted. Adjust the linkage to cause a slight bow(approximately 1/8 in.) in the lower forward nacelle skin with the gears fully retracted. This will eliminate vibration of the doors while in flight. The bolts in the attaching linkage should not be tightened to such an extent as to impair free action of the swivel or rod linkage.

Rig Main Landing Gear Door as Follows:

(a) Support aircraft on jacks.

NOTE:

When hoisting or jacking the aircraft always place a minimum of 200 pounds ballast on horizontal stabilizer to prevent air craft from tipping over. A felt or canvas pad should be used to protect the horizontal stabilizer and the ballast should be placed over thefront spar near the fuselage.

(b) Check the upper and lower limit switches to be sure they are correctly set.

(c) Disconnect landing gear door linkage on either left or right wheel and secure the doors back and out of the way.

(d) Adjust the landing gear door linkage which has not been disconnected and set the doors appresimately 12 plus or minus $\frac{1}{2}$ inch from landing gear piston. Measure from the lower forward corner of each door.

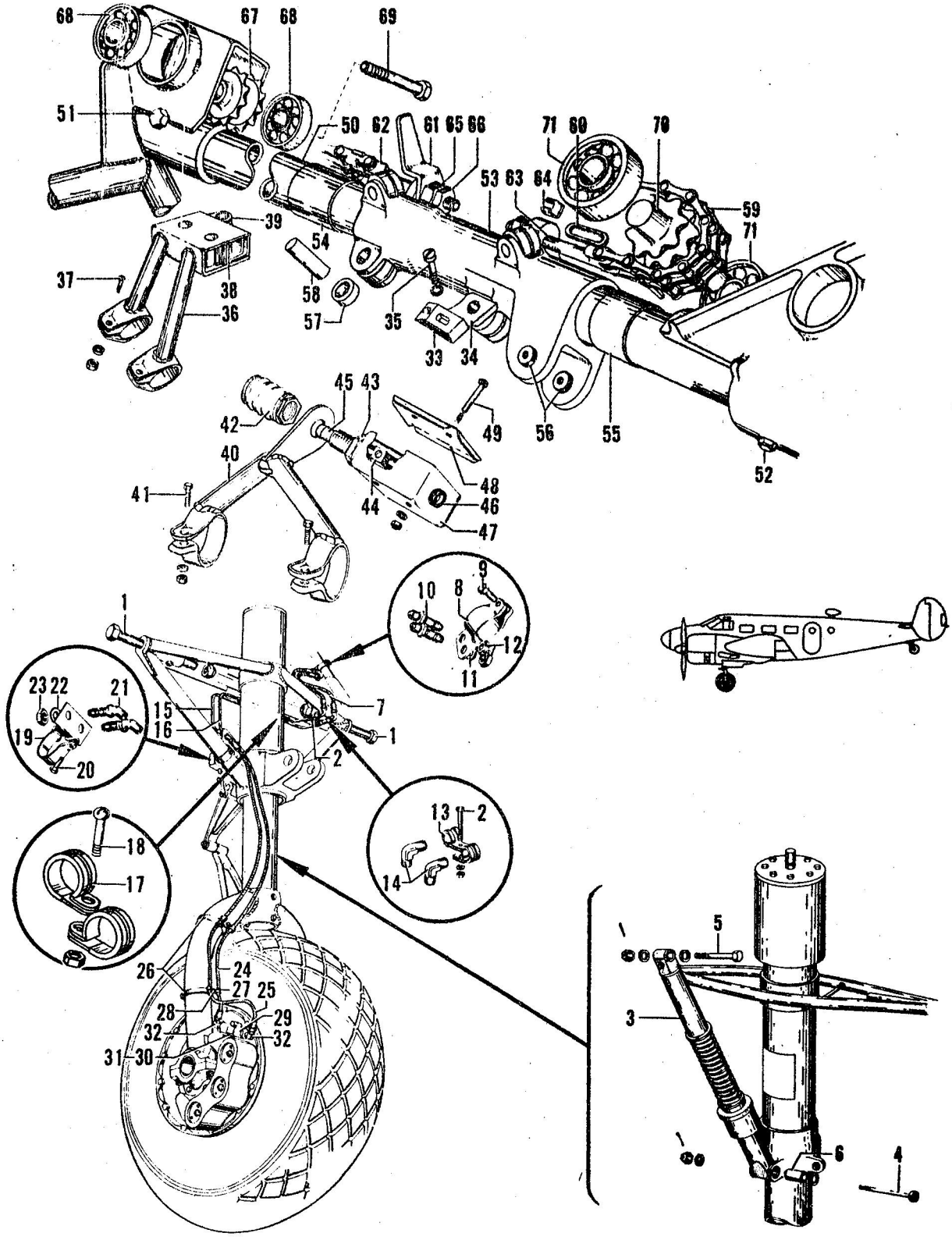


Figure 23. Landing Gear Installation

LANDING GEAR INSTALLATION

3 Leg Assembly - landing gear drag

6 Bushing

7 Hose Assembly

15 Tube Assembly - copilots brake LH

16 Tube Assembly - pilot brake RH

24 Hose Assembly - copilot brake

25 Hose Assembly - pilot brake

29 Valve - shuttle

30 Gasket

33 Actuator - light and limit switch upper

34 Bracket - light and limit switch upper LH and RH

36 Bracket Assembly - light and limit switch upper LH and RH

38 Switch - LH and RH

39 Actuator

40 Bracket Assembly - light and limit switch lower LH and RH

42 Boot Assembly - limit switch

44 Switch

45 Actuator

46 Grommet

47 Box - limit switch lower LH and RH

48 Cover Assembly - limit switch lower LH and RH

50 Tube Assembly - landing gear slide

53 Slide Assembly - landing gear retract

Note: The landing gear door linkage is adjusted by any one or all of the following means:

(i) Rotation of the clamps on the V-brace
(ii) Moving the linkage either up or down on the V-brace
(iii) Adjusting the clevis on the door linkage rod.

(e) Station one man in the pilots compartment and another man at the landing gear which is being rigged. The man in the pilots compartment will operate the landing gear position switch and the main outside the aircraft will watch the doors very closely as the gear is being retracted and make adjustments as required.

(f) With the battery master switch in the "OFF" position, connect an auxiliary power unit to the ground supply socket. Pull out the landing gear circuit breaker and select "UP" with the landing gear position switch. By intermittent operation of the circuit breaker, slowly retract the gear.

NOTE: Check landing gear torque shafts (left and right) to ensure that they will clear all lines, tubing and structural memebers of the aircraft.

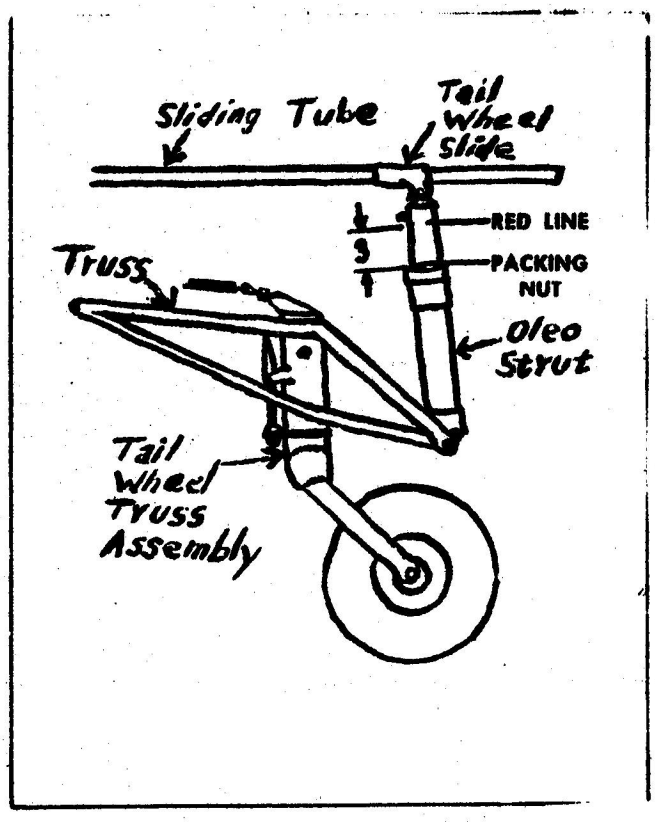
(g) Watch the doors closely as the gear is being retracted to be sure they will clear all lines, tubing and structural members of the aircraft.

NOTE A combination of any 2 or all of the methods for adjusting the door linkages (see note preceeding step (e) may be necessary to maintain the correct door dimension in "down" position, and to obtain proper rig and tension of the doors in "up" position.

(h) Run gears up slowly, checking carefully to be sure the doors clear the tire and landing gear fork. Maintain the $\frac{1}{4}$ inch minimum clearance between the door and tire, door and landing gear fork and door and wheel axle.

WARNING

Accumulative tolerances in the landing gear door linkage and the landing gear door swivel will allow approximately $\frac{1}{4}$ to 3/8 inch "play" in the landing gear door. When checking the $\frac{1}{4}$ inch clearance, push the door toward the wheel and remove the "play". Maintain the $\frac{1}{4}$ inch demension with the "play" removed.



Tail Gear Strut Inflation

(j) Adjust linkage to close doors snugly and cause a bow of approximately 1/16 to 3/32 inch of the nacelle.

(k) Check the doors for alignment. A small amount of forming with a rawhide mallet may be necessary to align the edges of the doors. Take care not to strike too hard and break the spot welds loose or distort the doors.

(l) Run gears down, tighten and key all bolts. Tighten and lock jam nut on the door rod linkage.

NOTE: The clevis head bolt attaching the rod end clevis to the door swivel should be tightened only finger tight.

(m) Repeat steps (d) through (l) for opposite gear
(n) Remove aircraft from jacks.

Landing Gear Motor

The landing gear motor located in centre section underneath the pilots floorboards.

It drives the landing gear mechanism through a worm gear drive enclosed in a gear box. On one side of the gear box is located a sprocket which connects by chain to the hand crank in the pilots compartment and a small sporcket which drives the tail wheel retracting mechanism. On the other side of the gearbox is a clutch which disengages themotor and gearbox from the other parts of the system.

Minor Repairs and Parts Replacement

(a) Brushes should be replaced when they are worn to a minimum length of 7/16 inch.

(b) A tension of 2 pounds should be required to lift the brush from the commutator. If tension required is less than 2 pounds replace spring.

(c) Clean the commutator with a gasoline moistened cloth and polish with fine sand paper. If commutator is extremely rough or pitted, replace motor.

NOTE For repairs other than exterior cleaning, replacement of brushes and springs, or cleaning of commutator the motor should be tagged unserviceable and returned to stores.

Landing Gear Motor Gear Box

The motor gear box is a cast magnesium sheel which houses the motor worm gear and the torque-shaft drive gear. The oil level in the box should be checked every 100 hours and maintained with universal gear lubricant, specifications MIL-L-6-86a. For every 400 hours the gears should be checked for wear as follows:

(a) Remove the motor and worm gear

(b) Inspect the torque-shaft drive gear for broken, damaged, or worn teeth. The maximum allowable wear on the teeth is 1/32 inch. Wear beyond this figure entains replacement of the gear.

(c) Check worm gear for rough, scored, or otherwise damaged teeth. If any marks are apparent which cannot be polished out, replace the worm.

(d) Ressemble the unit, ensuring that seal out is applied to the face of the gearbox which receives the motor.

Minor Repairs and Parts Replacement

If the gearbox and shaft assembly needs repair it must be removed, tagged unserviceable and returned to the stores.

Adjustments (landing gear clutch)

Clutch Cable Length Adjustment - to adjust the clutch cable length, hold the clutch pedal in the extreme aft position. Pull top of the clutch arm outboard, fully engaging the clutch. Place the bolt on the cable giving 1/16 plus or minus 1/32 inch clearance from the clutch arm. Tighten the bolt securely and safety. Actuate the clutch pedal several times to check the bolt for slippage and sufficient throw.

Overload Clutch Adjustment

(a) Remove the wrap lock clamp and friction tape holding the clutch dust cover in place and remove the cover. Loosen the lock screw on the tension nut.

NOTE: It may be necessary to spread the tension nut before it can be turned. Care must be exercised to avoid damage to the nut and the threads.

(b) Using beech spanner wrench 180131, tighten to increase the tension. Tighten the lock screw on the tension nut and safety. Replace the dust cover with friction tape and coat with shellac. Install wrap lock over tape.

Overload Clutch Testing

Testing of the overload clutch is accomplished with a spring scale connected to the hand crank. The test is made in the following manner.

(a) Place the aircraft on jacks so that all wheels are clear of the floor.
(b) Disengage clutch and raise gear approximately halfway with handcrank.
(c) Re-engage the clutch.
(d) Set the hand crank forward with the teeth engaged and hook a large spring scale to the handle at an angle of 90°. to the floor.
(e) Pull up stadily on the scale until the clutch slips, which should be at a reading of 130 plus or minus 10 pounds. If clutch does not slip within the allowable scale reading, and adjustment should be made.

Retracting Chain (nacelle)

Adjustment

To adjust retracting chains

(a) Support aircraft on jacks so landing gear wheels clear the floor.
(b) Using emergency hand crank, retract landing gear until slides in nacelles are about 1/8 inch from the lower stop.
(c) If this distance is not the same on both landing gears, tighten lower chain adjusting bolt in the slide that is further away from the stop(this will move the slide down), or tighten upper chain adjusting bolt on the slide that is closest to the stop (this will move the slide up).

NOTE: The chain adjustment will cover approximately $\frac{1}{4}$ inch difference of the slide assemblies. If the difference in the position of the slide is greater than $\frac{1}{4}$ inch the slide cannot be synchronized by adjusting the chain and the chain will have to be relocated on lower sprocket.

(d) The tension on the retract chains should be about 40 pounds. To set tension, tighten or loosen both adjusting bolts on chain by the same amount. Adjust chain so it does not slap slide tube during operation. This tension can be apprximated by grasping retract chain at about the centre and squeezing with thumb and forefinger. If chain can just be squeezed together, tension is satisfactory.

(e) Recheck slide measurements for synchronization.

Note : Chains should be checked at regular intervals, for possible wear Check measurements of 36 links from centre to centre on link pins. The measurement should be 18 to 18½ inches. If over 18 1/8 inches, chain should be replaced.

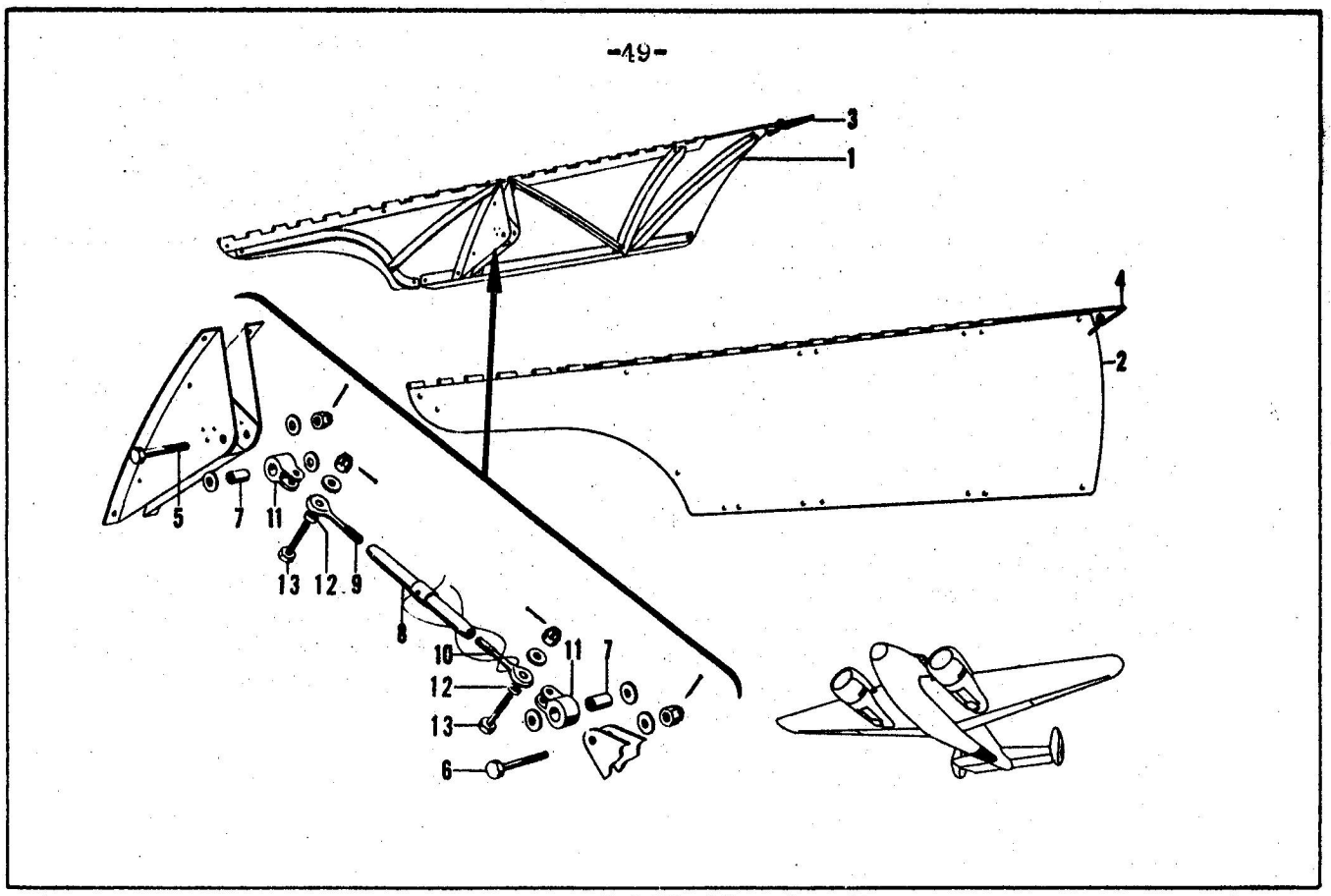
Note: Retract chains should be kept free of dirt, rust and corrosion at all times. Cleaning is accomplished only with approved solvent and under no circumstances should rust or corrosion be removed with an acid cleaner. This may embrittle and crack the highly heat treated links. If retract chain is excessively rusted or corroded to the exent of endangering safe operation, it should be replaced. The only recommended lubricant for retract chains is powdered graphite. A good method of application is to mix powdered graphite with a quick evaporating solvent and apply to the retract chain with a brush.

Slide Tubes

General

The slide tubes are constructed from chorme molybdenum, round, seamless steel tubing which, prior to installation, are cadium plated on the outer surface to resist rust and corrosion. They are securely attached at each end to the truss assembly and are adequately reinforced to absorb normal stresses induced by landing and take off. The exterior surface is smooth to permit the slide assembly to travel the entire length of the tube with the least possible drag. There are three slide tubes; one for each of the main gears and one for the tail gear.

CAUTION : Where it known or suspected that the geometric lock has been broken while the weight of the aircraft rested on the undercarriage, the slide tubes are to be throughly inpected for bending. Tubes showing any evidence of bending what soever are to be replaced.



Tail Wheel Door Assembly

1 Door Assembly - tail wheel LH
2 Door Assembly - tail wheel RH
3 Pin - tail wheel door hinge LH
4 Pin - tail wheel door hinge RH
5 Bolt - aircraft no 10-32 x 1 1/8 inch
6 Bolt - aircraft no 10-32 x 1 inch
7 Bushing
8 Barrel - tail wheel turnbuckle
9 Eye - tail wheel door turnbuckle LH
10 Eye - tail wheel door turnbuckle RH
11 Link Assembly - tail wheel door universal
12 Bushing
13 Bolt - aircraft no 10-32 x 3/4 inch

Landing Gear Slide Assembly

The landing gear slide assembly consists of a steel forging machined to accommodate 6 steel rollers. The rollers are evenly spaced to give a smooth sliding operation. Machined on the forging are two fittings for the retract chain attachment. The forging is lined with the bronze bushing to assure free action on the slide tube.

Minor Repairs and Parts Replacement

The landing gear slide assemblies should be kept clean at all times. If bronze bushing is excessively worn or scored, replace slide assembly. Replacement of also drag leg is recommended if attaching bolt holes are elongated or worn.

Landing Gear Torgue Shaft

Minor Repairs and Parts Replacement

If torque shaft becomes bent or warped, remove and replace the entire torque shaft assembly.

Tail Wheel Retracting Systems

Cables from a chain and sporcket drive on the main landing gear torque unit are attached to the tail wheel slide assembly. The shock absorber links the slide and the tail wheel truss. As the slide is moved along the slide tube, the shock absorber lowers or retracts the tail gear.

Minor Repairs and Parts Replacement

(a) If a cable has more than 6 strands broken in any 1 inch it must be replaced.

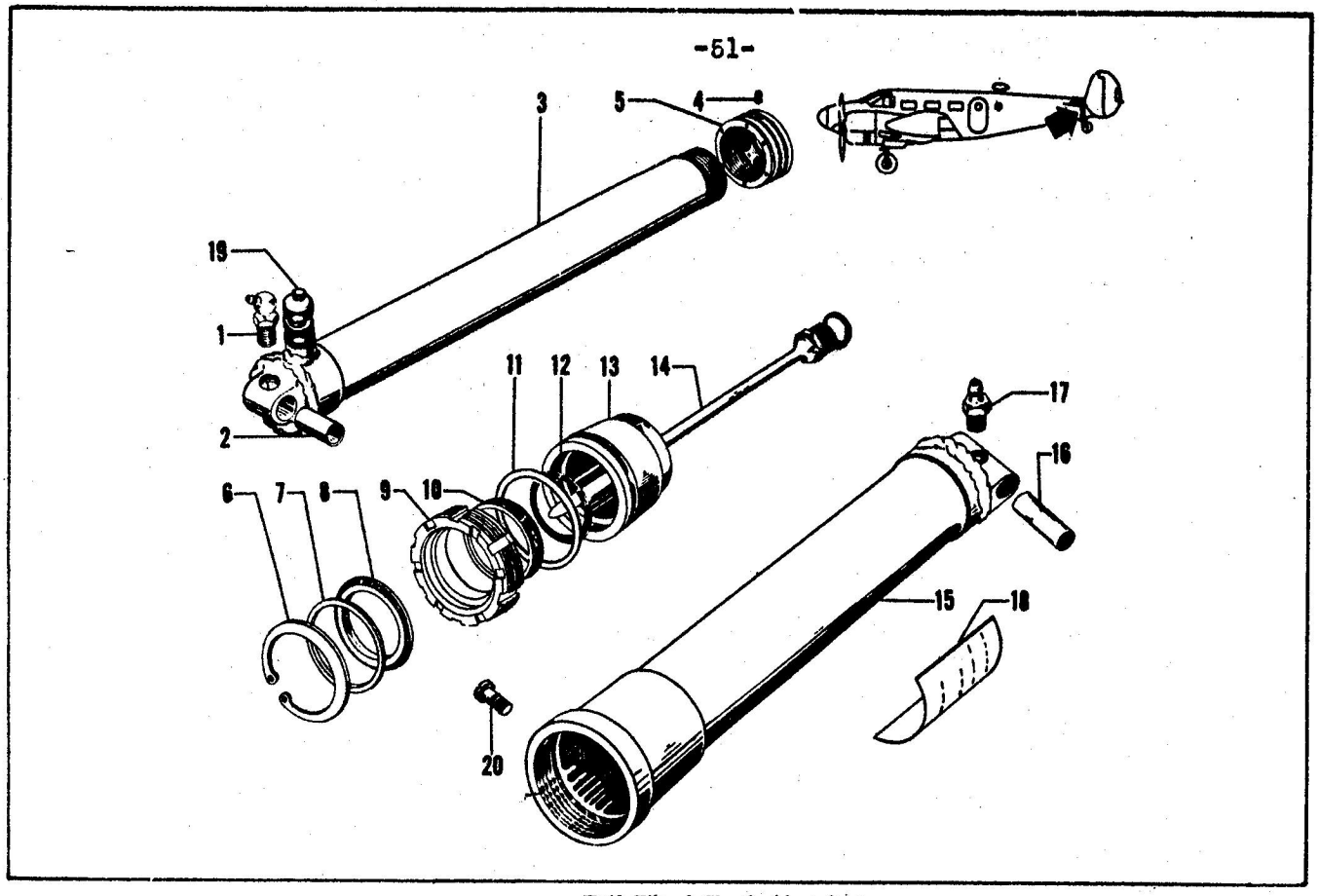
(b) Rusted or corroded chains must be replaced.

(c) Replace pulley's which are frozen or sticky in operation.

(d) Check the bushings in the idler sprockets for rust or corrosion and lubricate as required.

(e) Check idler sprockets for excessive wear.

(f) Worn sprockets must be replaced.



Tail Wheel Shock Absorber

1 Fitting - grease
2 Bushing - tail wheel shock
3 Piston - tail wheel shock
4 Screw - allen head $\frac{1}{4}$ - 20 x $\frac{1}{4}$ inch
5 Head - tail wheel shock piston
6 Ring - snap
7 Spacer - Tail wheel shock wiper ring
8 Ring - wiper
9 Nut - packing
10 Pad - felt
11 Gasket
12 Packing - O ring
13 Adapter - shock absorber piston
14 Pin - metering
15 Cylinder - tail wheel shock
16 Bushing - shock assembly
17 Fitting - Grease
18 Placard - Tail wheel shock
19 valve assembly
20 Screw - set

Rigging Tail Wheel Retract Cables.

(a) Support aircraft on jacks.

(b) Station a man in pilots compartment, a man in the rear fuselange tail compartment, and a man outside of aircraft. The man in pilots compartment will operate the landing gear manually and electrically, theman in rear fuselage will adjust the retract cables to proper tension, and the man outside will see that the wheel wells are clear of obstructions each time the gear is operated and check the tail wheel slide for synchonization with the main gear slides and correct travel.

(c) Operate landing geary system manually and positi on the main gear slides against lower stops. Adjust turnbuckles on the tail wheel retract cables until the cables have approximately 50 pounds tension on each. Make sure the tail wheel slide is against thelower (aft) stop.

(d) Operate gears electrically and check the lower limit switch for coerect setting.

CAUTION : Use extreme care when operating the system electrically. Added inertia in the landing gear system, caused by electrical operation, may cause the landing gear slides to contact the lower stops too hard and damage the retract system. An approximate setting may be obtained on the lower limit switch by manual operation, however, it should not be relied upon as a final correct setting to limit travel of the gear when under electrical operation. It is recommended that the lower limit switch be adjusted initially to such a position where it will be reasonably certain that the slides will not contact the lower stops with undue force when the slides will not contact the lower stops with undue force when the system is operated electrically. Continual electrical operation and adjustments by trail and error method until correct setting is obtained.

(e) Using a tensiometer to check cable tension, adjust retract cables to 70 plus or minus 5 pounds on the top retract cable and 50 plus or minus 5 pounds on the bottom cable.

NOTE: If the above tensions cannot be obtained with the tail wheel slide against the lower stop, with 3 threads or less showing at the ends of the retract cable turnbuckles, the chain must be relocated on the idler sprocket in the belly. After chain is relocated on sprocket, operate gear manually to check synchronization of the tail wheel slide with the main gear slides.

(f) Run the gear to fully retracted position, then lower against the lower stop electrically. The man in tail compartment will listen carefully to assure the tail wheel slide contact the loser (aft) stop with a slight impact (barely audible) and the man outside will make a check through the tail wheel opening to be sure the slide is contacting the lower (aft) stop.

(g) Check cable tension and lower limit switch setting. Make minor adjustments in cable tension and lower switch setting if necessary. Safety the turnbuckle.

WARNING: The tail wheel retract cable is attached to the tail wheel slide with an aluminum alloy shear bolt. Never replace this aluminum alloy shear bolt with a steel bolt.

LANDING GEAR ELECTRICAL SYSTEM

Location - Position switch accompanied by red UP light and a green DOWN light is located on pilots control pedestal.

This switch is readily identified by a miniature wheel mounted on the switch handle. This switch when actuated, controls the landing gear motor, through the dynamic brake relay. Limit switches, safety switches and position light switches form the rest of the circuit.

Limit Switches

Upper Limit Switch

Location - Is mounted on the truss tube near the top of the left nacelled.

The switch is operated by the actuator lug mounted on the slide assembly and regulates the travel of the landing gear as it is being retracted.

Adjustment

To adjust upper limit switch

(a) Support aircraft on jacks so that all the wheels are clear of the floor.

WARNING:

When hoisting or jacking the aircraft, always place a minimum ballast of 200 pounds on the horizontal stabilizer to prevent aircraft from nosing over. Ballast should be placed over the front spar near the fuselage.

(b) Remove upper bolts from both drag legs and swing drag-legs down, free of slide.

(c) Position upper limit switch bracket on truss members so from the edge of the forward mounting clamp on the bracket is 7 3/8 iches from the upper stop. Tighten bolts just sufficiently to secure bracket, so that it will move when struck a firm blow with a rubber or rawhide mallet.

(d) Install actuator wedge on upper drag leg bolt and slip bolt into the slide. Do not install drag leg.

(e) Retract slide slowly with handcrank

(f) Observe clearance between actuator wedge and the switch bracket, Maintain 1/16 inch minimum clearance.

(g) Position slide 1/8 inch from the upper stop and by rotating the bracket, set the switch lever roller near the centre of the actuator wedge. Set the switch so the actuator wedge trips it.

(h) Crank gear down and install drag leg. Retract gear electrically and check the position of the slide. Maintain the 1/8 inch gap between slide and stop.

(j) Make minor adjustments by rotating bracket on the truss.

(k) Extend and retract the gear 2 or 3 times to be sure the 1/8 inch gap is maintained. Key all bolts.

NOTE : Make final check with both drag legs installed.

Lower Limit Switch

Location - lower end of the left landing gear slide tube. It regulates the travel of he landing gear as it is being extended.

Adjustment

To adjust undercarriage lower limit switch:

(a) Support aircraft on jacks so all wheels are clear of floor.

(c) If the slide hits the stop too hard, retract the gears 2 or 3 inches from the lower stop and relocate lower switch mounting bracket slightly forward. If the slide does not hit the stop firmly locate the switches aft. Retract gears electrically and check the upper limit switch setting. Continue until switches are set correctly.

CAUTION : Do not set the lower limit switch to impose an abnormal stress on the landing gear torque shafts and landing gear motor mechanism. To check the load make a mark across the clutch teeth and release the clutch. The resulting " spring-back" of the clutch engaging teeth should be no more than $\frac{1}{2}$ of the width of 1 tooth. If this is exceeded, relocate the lower switch mounting bracket slightly forward.

(d) Tighten bolts securely holding switch and bracket.

Landing Gear Position Light Switches.

Location - Position light switches in the right nacelle control the red and green indicator lights on pilots control pedestal which register the full "UP" or "DOWN" position of the landing gear.

When the gear is in the "UP" position the red light is on; as the gear is being lowered, the circuit is opened leaving both lights off until the down position is reached, at which time the green light comes on.

Adjustment

To adjust upper position light switch.

(a) Support the aircraft so all wheels are clear of ground.

WARNING: When jacking always have 200 pound ballast, positioned on front spar of horizontal stabilizer near to the fuselage.

(b) Retract slide manually until slide is approximately 5/16 inch from full "up" position.

(c) Loosen switch bracket and set switch so red light just comes on. Maintain 1/16 inch minimum clearance between actuator wedge and switch bracket.

(d) Lower slide, attach both drag legs, then retract; check operation of red light on pilots control pedestal.

(f) Tighten lock nuts holding switch barrel.

Landing Gear Switch Latch

The solenoid operated switch latch in the control pedestal engages and locks the position switch in the "DOWN" Position, preventing accidental retraction while the weight of the aircraft is on the gear. As the shock strut (right) extends it actuated the control switch opening the circuit to the solenoid, which in turn releases the latch. In emergencies the switch latch may be released manually through a hole in the left side of the control pedestal.

Adjustments

To adjust landing gear switch latch:

(a) Support aircraft on jacks as the weight is off the landing gear.

(b) Release the air from the shock absorber.

(c) Place a small jack under the shock absorber fork and raise wheel untill shock absorber is compressed $\frac{1}{2}$ inch.

(d) Adjust actuating bolt until switch clicks.

(e) Adjust lock nut on actuating bolt and lock bolt in this position.

(f) Lower wheel, then raise again to the point where the switch clicks.

(g) Check position switch to see that it is locked in the "DOWN" position. Lower wheel, then see that switch is unlocked.

(h) Remove jack from under wheel and partially inflate shock strut.

(j) Remove jack from under aircraft and inflate shock strut.

Landing Gear Safety Switch

Location - on the left shock-absorber sturt.

Prevents accidental retraction of the landing gear while it is supporting the weight of the aircraft. This switch is in the "UP" landing-gear control circuit between the landing gear position switch and the landing-gear dynamic brake relay. When the shock strut is compressed it opens the "UP" landing gear control circuit.

Adjustment

Te adjust safety switch:

(a) Support aircraft on jacks as weight is off the wheels.

WARNING: When hoisting or jacking the aircraft, always place a minimum ballast of 200 pounds on the horizontal stabilizer to prevent aircraft from nosing over. A felt or canvas pad should be used to protect the horizontal stabilizer and the bal last should be placed over the front spar near the fuselage.

(b) Release air from the shock absorber.

(c) Place a small jack under the shock absorber fork and raise wheel until shock absorber is compressed $\frac{1}{2}$ inch.

(d) Adjust actuating bolt until switch clicks.

(e) Raise wheel, then lower it carefully to the point where switch clicks again. Mark this location of shock strut and then release the jack from under the wheel. The distance from this mark with shock fully extended should be $\frac{1}{2}$ inch.

Dynamic Brake Relay

Location - under the pilot's floorboards is incorperated in the landing gear circuit between the position and limit switches and motor.

It prevents over travel of the gear and coasting of the moter after the upper or lower gear limits have been reached.

The up and down relay solenoids are controlled by the position switch on the control pedestal and the limit switches in the left nacelle. Either the position switch or the limit switches will energize and de-energize the solenoids. Contactters on the solenoids plungers complete the running circuit when the solenoid is energized, but remain normally closed in the braking circuit when the solenoid is de-energized. A rocker arm contact operated by arms on the solenoid plungers selects for braking the field opposite to the one last used for running. Counter voltage induced in the motor armature as the motor is running returns to ground through the opposite field and the relay when the control circuit is broken thereby braking the armature.

Minor Repairs and Parts Replacement

Repairs on the relay should be limited to:

(a) Tightening connections.

(b) Keeping contacts clean, or replacement of the entire relay.

NOTE : No attempt should be made to repair or adjust the relay except by authorized personnel.

Testing

Note: If after running the following tests the relay proves to be malfunctioning, it should be tagged unserviceable and returned to stores.

(a) Support aircraft on jacks so all wheels clear the floor.

(b) Disconnect leads at motor and turn on electrical system. (Tape these leads to prevent them from becoming grounded)

(c) Test (with 24 volt test light) continuity from main power terminal in belly of aircraft to the No. 3 terminal on the dynamic brake relay.

(d) Manually set the landing gear so that both limit switches are clear of the slide assembly actuator and place the landing gear position switch in the "UP" position (for testing "UP" solenoid).

(e) Test from Terminal No. 1 of the relay assembly to ground; if the "UP" solenoid contactor is making proper contact, the test light will be on.

(f) Holding the position switch in a neutral position or operating the "UP" limit switch, should cause the test light to go off.

(g) Repeat the same test for the "down" doleneid by placing the position in "DOWN" position and testing from Terminal 2 of the relay assembly to ground. If the down solenoid contactor is making proper contact, the test light will go on.

(h) Holding the position switch in a neutral position or operating the down limit switch should cause the light to go off.

Warning-Horn Switches

General - Location - Located in the pilot's control pedestal in front of the throttle levers.

Their function is to energize the warning - horn circuit and sound the horn if the throttles are closed beyond a safe flight setting with the landing gear retracted. This circuit is interconnected with the down position light switch, therefore, the warning horn stops sounding as the green position light comes on.

Adjustment

To adjust warning-horn switches:

(a) Set parking brake, check wheels, and start the engines.

(b) Advance throttles until manifold pressure guages whows 12 inches of manifold pressure with the propeller in fine pitch.

(c) Move mixture controls to Idle Cut-Off position and stop engines leaving throttles in the same position.

(d) Gaining access through the nose section the throttle switches, loosen clamp holding switches.

(e) Move switches in contact with throttle until a click is heard, indicating that the switches have closed.

(f) Secure switches in this position.

(g) Aircraft should be flight tested to determine if switches function properly in flight.

Warning Horn Cut-Out Relay

Location - push button is located below the inner beacon light on the main instrument panel.

When the undercarriage is up and either throttle is retarded the warning horn will sound. Depressing the warning horn silencer button energizes the silencer relay, which in turn breaks the warning horn circuit. The relay will remain energized and, hence, silence the horn until either the throttles are advanced or the undercarriage is lowered.