Chapter 17 MAIN UNDERCARRIAGE JACK

(Completely revised)

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LIST OF ILLUSTRATIONS

Introduction *(fig. 1)*

1. This unit consists of a basic jack, together with a restrictor valve and swivel pipe unit. An internal mechanical lock is incorporated which secures the piston in the extended position and which must be hydraulically released before the piston can move to the closed position. Provision is also made for lock indicator micro-switches. The swivel pipe unit is attached to its boss by set bolts and incorporates the restrictor which prevents the jack being closed too rapidly. The jack is extended by the gravitational fall of the unit to which it is attached and an air vent in the cylinder adjacent to the attachment point prevents cavitation above the piston during extension of the jack. A basic type is described in the chapter and variants are covered in the appendices.

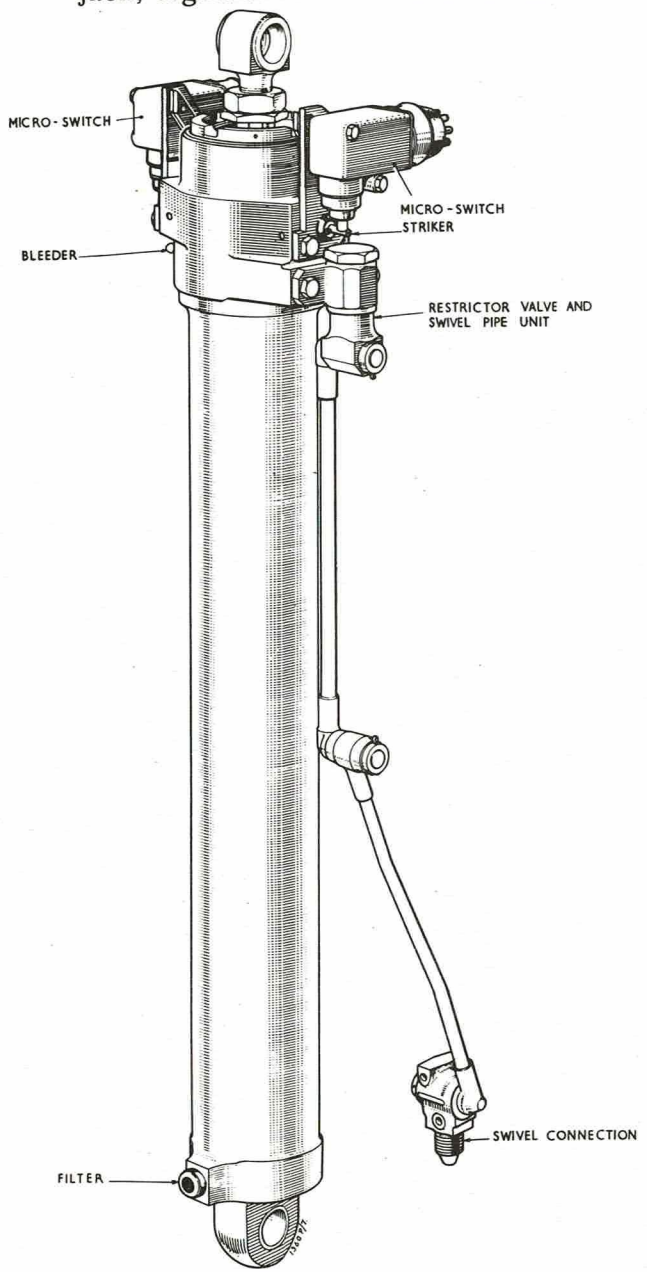

Fig. 1 Main undercarriage jack

Description *(fig. 2)*

2. At the open end the cylinder receives a spring housing and is formed with two diametrically opposed bosses to which the micro-switch mounting plates are bolted. A micro-switch striker pivoting on a pin protrudes through each boss for actuation by a locking sleeve. Adjustment of the micro-switches, in relation to their strikers, is made possible by the slotted holes in the plates. A third boss forms a fluid connection to which the spigot of the restrictor valve and swivel pipe unit is attached. At the closed end of the cylinder, a bushed lug receives an attachment pin and an adjacent boss forming the air vent is fitted with a filter.

3. The spring housing fitted with a wiper ring, retains a lock sleeve housing, a distance piece, and a travel stop against a shoulder in the bore of the cylinder. The distance piece is located by a pin in the lock sleeve housing, which is located axially by the protruding stem of a bleeder adapter, screwed into the cylinder opposite to the fluid connection. A spring loaded locking sleeve operates in the bore of the locking sleeve housing and receives a gland assembly, consisting of a gland nut, a gland ring and a spacer. A sealing and backing ring seals the locking sleeve in the housing which is similarly sealed in the cylinder bore. The spring is interposed between the locking sleeve and a travel stop which abuts the spring housing and limits the movement of the locking sleeve.

4. The inner end of the hollow piston rod is threaded for a piston head which is retained by a pin, secured by a washer and split pin. A sealing and backing ring seals the rod in the piston which is sealed by a sealing ring interposed between two piston rings in the cylinder. The skirt of the piston is fitted with six chamfered locking slips, inserted radially and each located by a screwed spigot. The slips are free to move radially towards, or away from the piston rod. The outer end of the rod is slotted for a spanner grip and threaded for the attachment of a bushed eye-bolt fitted with a locknut.

Restrictor valve and swivel pipe unit (fig. 3)

5. The unit consists of two pipe assemblies forming a centre swivel joint and having fixed connections at the outer ends for attachment to the jack and airframe respectively. The

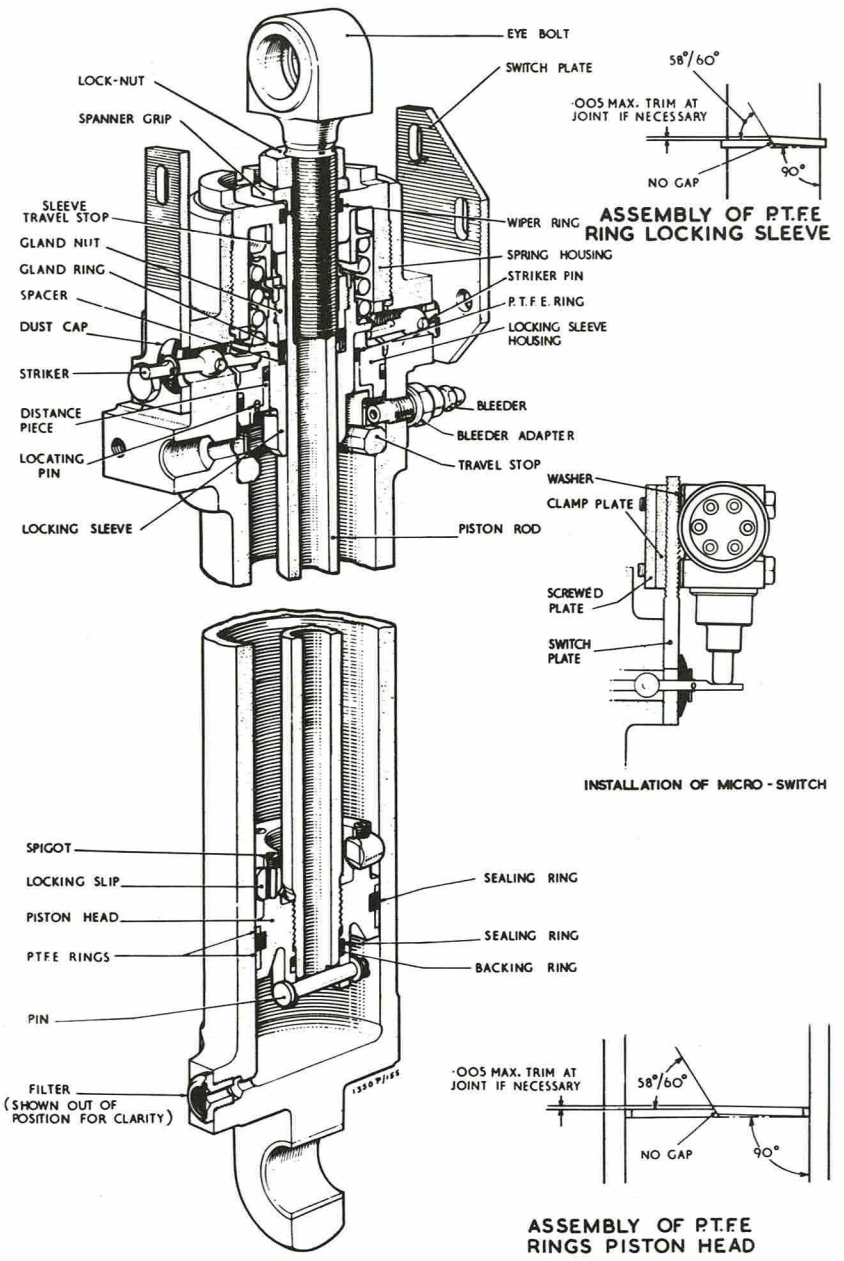

Fig. 2 Main undercarriage jack details

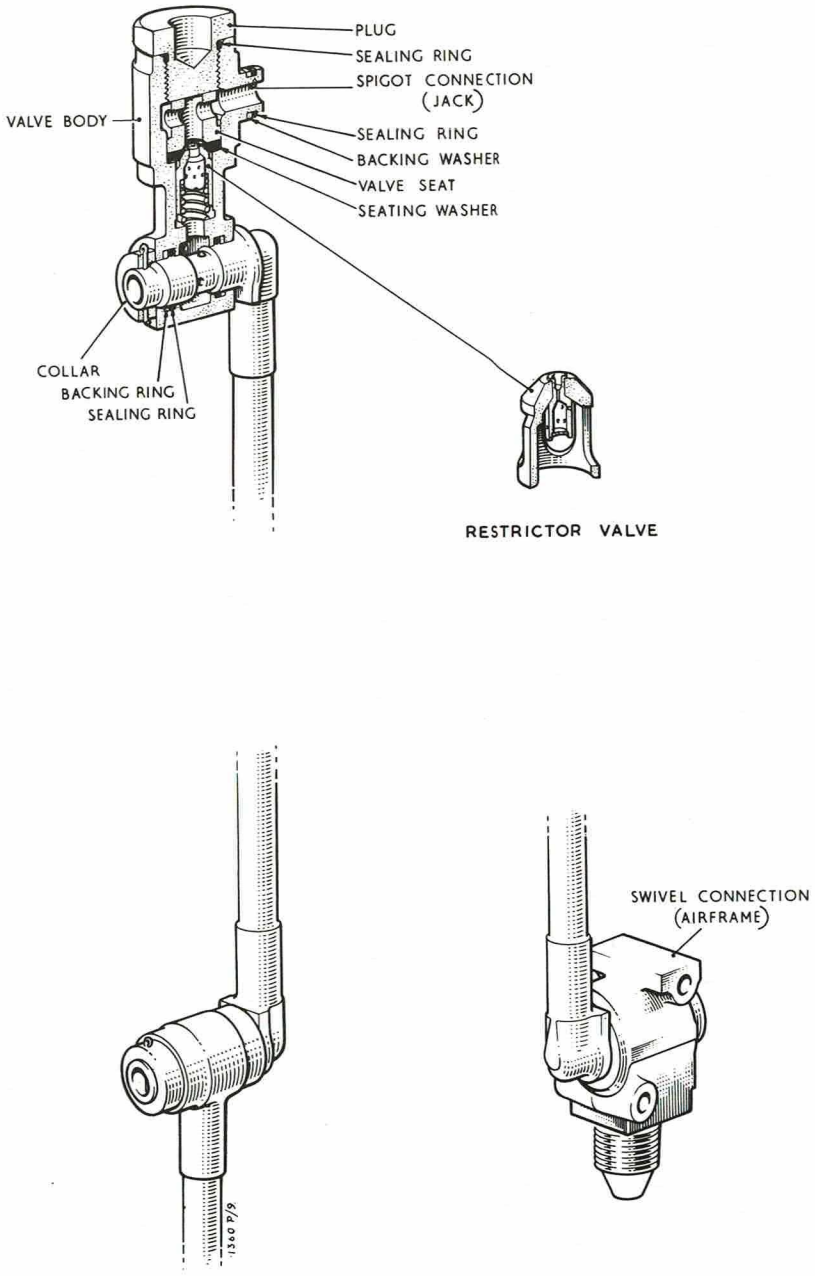

Fig. 3 Restrictor valve and swivel pipe unit

swivel joints each consist of a coupling post rotating in a coupling body and retained by a collar secured by a split pin. The bore of each coupling post, sealed by a screwed plug soldered in position, is linked by radial holes to an annular groove in the post, which coincides with an annular groove in the body. Additional grooves in the coupling, house sealing rings and backing rings to prevent the leakage of fluid. The pipes are brazed into the relevant posts and coupling bodies.

6. The airframe connection has lugs for attachment purposes and is formed integral with a pipe adapter. The jack connection consists of a valve body into which is screwed a plug retaining a restrictor assembly. The plug is fitted with a sealing ring, and the body, which is flanged for attachment to the jack, is formed integral with a spigot connection grooved for a sealing and backing ring. The restrictor assembly comprises a spring loaded valve which houses a restrictor and seats against a rubber washer supported by a valve seat. The restrictor is hollow and has an orifice of small diameter at one end and is closed at the other end by a plate peened in position. Radial holes allow flow of fluid into the bore.

Principle of operation *(fig. 4)*

7. When the piston rod moves to extend due to the gravitational fall of the unit to which it is attached, the displaced fluid is restricted by the valve in the swivel pipe unit at the piston rod end. The speed of extension is thus reduced. As the piston approaches the limit of travel, the slips on the piston are forced inwards as they pass along the bore of the travel stop; they then strike the face of the locking sleeve, which is then compressed against its spring until the piston has reached the limit of its travel. The locking sleeve under spring pressure then forces the slips radially outwards to engage on the outer chamfer of the travel stop, where they are retained by the locking sleeve as it returns to its original position under the action of the spring.

8. With the jack extended and locked, fluid entering via the swivel pipe unit passes through the lock sleeve housing, to move the locking sleeve against its spring. When the lock sleeve is clear of the piston, the slips disengage from the travel stop to unlock the jack. The fluid also acts on the piston and commences to close the jack, the slips on the piston being forced inwards as they pass through the travel stop. When the fluid pressure is released, the locking sleeve returns to its normal position under the pressure of its spring.

Leakage

9. External leakage will indicate a faulty seal which must be renewed. Internal leakage past the piston head sealing ring will be shown by sluggish action of the jack in service or

SERVICING

TABLE 1

Special tools

Ref. No.	Part No.	Description
27Y/2370	RS.181/14	'C' spanner for piston head
27Q/12290	ST.1215	Vice clamp for collets
27Q/12985	ST.1215/2	Collet for use with vice clamp to hold locking sleeve
27Q/22494	ST.1215/14	Collet for use with vice clamp to hold piston rod
27Q/12408	ST.1900 Mk. 3	Drift for assembly of bushes in eye-bolt
27Q/13487	ST.1900 Mk. 5	Drift for bush in eye-end
27Y/4318	RS.181/33	'C' spanner for spring housing
27Q/22491	ST.2700	Extractor for bushes in eye bolt
27Q/22492	4.60001.091	Post for assembly of 'O' rings
–	–	¼in. socket torque spanner (set at 50 lb.in.) for set bolts securing restrictor and swivel pipe unit to jack
27Q/22160	03195T.A01	Assembly post for assembly of gland ring over piston rod.

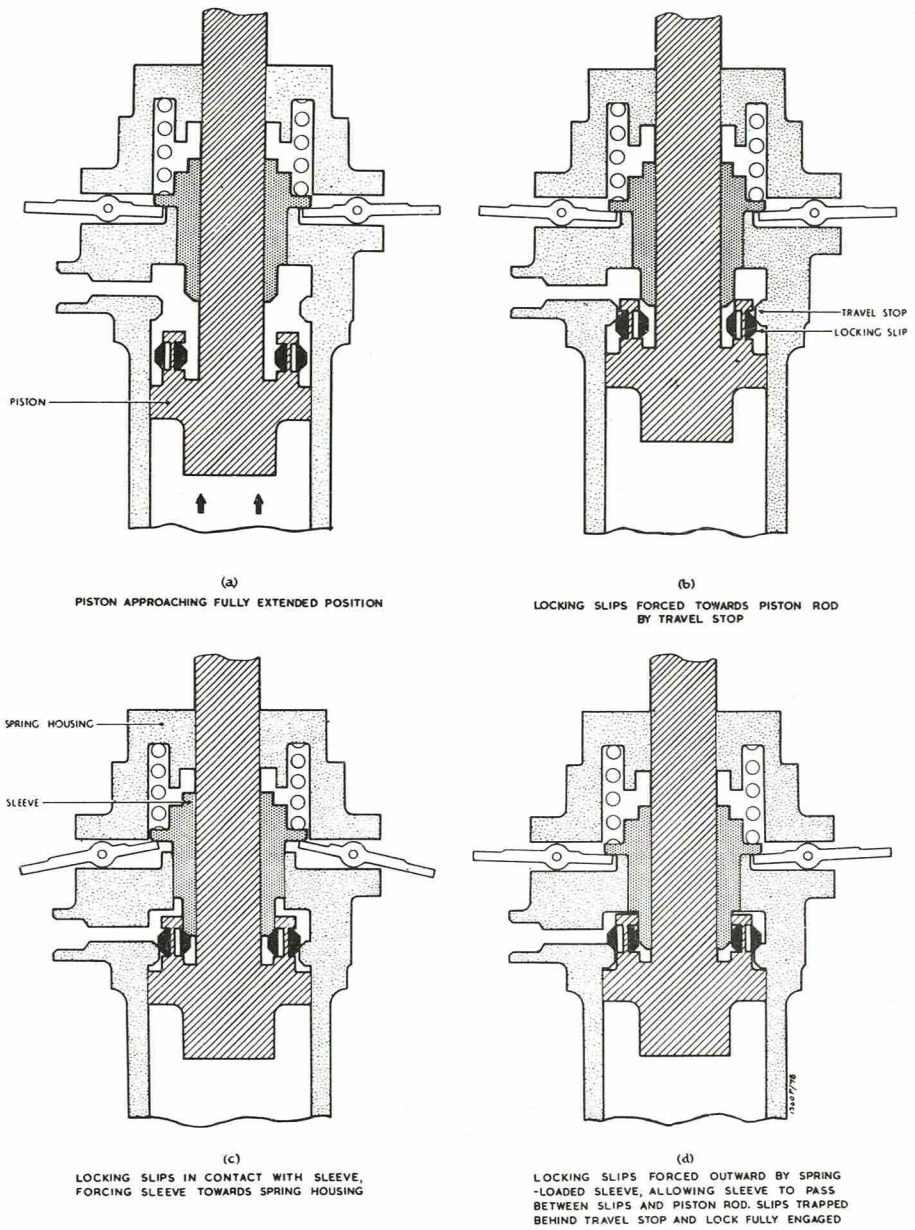

Fig. 4 Operation of lock

loss of pressure during test. Renew the sealing ring. Increased flow past the restrictor valve will necessitate a new seating washer.

Dismantling

Jack

10. (1) Remove the restrictor valve and swivel pipe unit from the jack.

(2) Unscrew the filter from the cylinder.

(3) Unscrew the bolts and remove the micro-switches, together with the washers, the clamp plates and the screwed plates from the switch plates.

(4) Extract the split pin from each striker pin, then remove the washer and rubber dust cap.

(5) Unscrew the set-screws and remove the switch mounting plates from the cylinder.

(6) Unscrew the bleeder adapter from the cylinder. Remove the bonded seal and unscrew the bleeder from the adapter.

(7) Punch the striker pins from the cylinder bosses and withdraw the strikers.

(8) Slacken the lock nut and unscrew the eye-bolt from the piston rod. Remove the spanner grip.

(9) Unscrew the spring housing and withdraw the sleeve travel stop and spring from the cylinder. Remove the wiper ring from the spring housing.

(10) Withdraw the lock sleeve from the piston rod. Unscrew the gland nut and remove the spacer and 'U' ring from the sleeve.

(11) Withdraw the piston rod complete with the travel stop and lock sleeve housing from the cylinder. Slide the sleeve housing and travel stop off the rod, then remove the distance piece, locating pin and sealing rings from the sleeve housing.

(12) Remove the split pin and washer then withdraw the pin from the piston head. Unscrew the piston head from the rod and remove the sealing and piston rings.

(13) Unscrew the spigots and remove the locking slips from the piston head.

Restrictor valve and swivel pipe unit

11. (1) Remove the split pins and collars from the swivel joints and withdraw the swivel connections from the posts.

(2) Remove the sealing and backing rings from the swivel connection bodies, and from the spigot on the swivel connection valve body.

(3) Unscrew the plug and remove the sealing ring, then withdraw the valve seat, seating washer, valve and spring from the body.

Assembling

Restrictor valve and swivel pipe unit

12. All sealing rings, except bonded seals, are to be lightly coated with Grease XG-315 (34B/9100519) before being assembled in the unit.

(1) Position the spring in the valve, then with the spring leading, insert the valve into the connection valve body.

(2) Insert the washer and the valve seat with the inner chamfers leading, into the body. Fit the sealing ring to the plug and screw the plug into the body. Wire-lock the plug to the body.

(3) Fit the sealing and backing ring to the spigot connection of the valve body, and sealing rings and backing rings to the connection bodies, with the rough faces of the backing rings adjacent to the sealing rings.

(4) Slide the connection bodies over the relevant coupling posts and secure the assemblies with the collars and split pins.

(5) Carry out the tests as detailed in the appropriate appendix.

Jack

13. (1) Position the locking slips in the skirt of the piston head, and secure in position with the spigots, screwed in flush with the face. Lock each spigot by peening metal into the screw driver slot.

(2) Fit the sealing and backing ring in the bore of the piston head, with the rough face of the backing ring adjacent to the sealing ring, and screw the head on to the piston rod, almost flush with the end of the rod. Align the pin hole with the nearest slot in the rod, insert the pin and secure with the washer and split pin.

Note . . .

The piston rod must not protrude beyond the piston head.

(3) Fit the sealing ring and the P.T.F.E. rings to the piston head. The P.T.F.E. rings are to be assembled as shown in the detail view of fig.2.

(4) Insert the piston into the cylinder, then slide the travel stop, with the larger of the two inner chamfers trailing, over the piston rod and into the cylinder, until it abuts the shoulder in the bore.

(5) Fit a bonded seal to the bleeder adapter and screw the adapter into the cylinder tapping diametrically opposite the swivel connection boss. Screw the bleeder screw into the adapter and lightly tighten. Wire-lock the adapter to the adjacent cylinder boss. The

bleeder screw will be wire-locked after installation of the jack in the aircraft.

(6) Fit the locating pin and the sealing and backing ring to the lock sleeve housing. The rough faces of the backing ring must be adjacent to the sealing ring.

(7) Assemble the P.T.F.E. ring to the locking sleeve housing as shown in the detail view of fig.2, with its chamfered face abutting the flange; follow with the sealing ring.

(8) Insert the distance piece into the lock sleeve housing and locate the small hole in the shoulder of the distance piece over the locating pin.

(9) Visually align the slot in the lock sleeve housing, with the stem of the bleeder adapter protruding into the cylinder, and with the distance piece leading, insert the housing into the cylinder, and ensure that the slot locates over the stem and the housing abuts the travel stop.

(10) Position the groove of the 'U' ring on the stem of the spacer, and with the spacer leading, insert the 'U' ring into the locking sleeve. Screw the gland nut loosely into the sleeve and with the gland nut trailing, slide the locking sleeve on to the rod. Tighten the gland nut and wire-lock the nut to the sleeve.

Note . . .

The locking wire must rest in the groove on the locking sleeve, and must not be wound over the end face of the sleeve or gland nut.

(11) Push the locking sleeve into the lock sleeve housing until the flange on the sleeve abuts the housing. Fit the wiper ring in the bore of the spring housing, and locate the sleeve travel stop, flange leading, followed by the spring into the housing. Screw the spring housing into the cylinder to abut the lock sleeve housing. Wire-lock the spring housing to the cylinder.

(12) Screw the lock-nut fully on to the eye-bolt, locate the spanner grip to the end of the piston rod and screw in the eye-bolt. The eye-bolt will be finally adjusted and locked on installation of the jack in the aircraft.

(13) Insert the strikers into their relevant bosses with the flat face of each striker adjacent to the flange of the lock sleeve. Retain each striker in its respective boss by inserting the pin, peening each end to secure in position.

(14) Locate the switch plates on the cylinder and secure them in position with the set-screws. Wire-lock the set-screws to the cylinder. Fit a dust cap over each striker and retain in position with a washer and split pin.

(15) Position a clamping plate and a screwed plate behind each switch plate and secure the micro-switches with the bolts and washers. The washers are to be located between the switch and the switch plate as shown in fig. 2, with the bolts lightly tightened.

Note . . .

The micro-switches are adjusted by moving them up or down in the slots in the bracket. This adjustment is described in para. 14.

(16) Screw the filter into the boss at the closed end of the cylinder and lightly tighten, the filter will be finally locked on installation of the jack into the aircraft.

(17) Secure the restrictor valve and swivel pipe unit to its boss on the cylinder with the set-bolts. Tighten the set-bolts with a torque loading of 50 lbf. in. Wire-lock the heads of the set-bolts.

(18) Carry out the tests as detailed in the appropriate appendix.

Micro-switch adjustment

14. With the piston rod fully extended and locked, adjust the position

of each micro-switch until the plunger of the switch is depressed by the striker 0·165 to 0·190 in. Tighten the bolts securing the micro-switches and wire-lock the heads of the bolts together.

Appendix 1 MAIN UNDERCARRIAGE JACK UNIT

Type No. 1.00473.001

Introduction

1. This jack is identical to the type described in the chapter.

TEST SCHEDULE

Test equipment

2. A static hydraulic test rig and a power pump rig fitted with a pump capable of delivering 3·45 gal. per minute are required. All pipes between the test rigs and the jack are to be $\frac{3}{8}$ in. outside diameter for metal pipes or $\frac{3}{8}$ in. nominal for flexible hose. The micro-switches should be wired to a suitable electrical circuit to give visual indication by lights of the correct functioning of the locking mechanism. Before testing, the jack is to be hydraulically operated at least six times to expel all air.

3. For testing the swivel pipe unit, a test adapter Part No. 4.60001.240 and a test valve Part No. 4.60001.241 will be required.

Testing the restrictor valve and swivel pipe unit

4. (1) Remove the restrictor valve from the body and fit the test valve. Connect the supply line of the static hydraulic test rig to the airframe connection and gradually apply a pressure of 3,300 lb/in^2. Leakage at the jack connection must not exceed 1·85 c.c. per minute. Release the pressure, remove the test valve and replace the original valve.

(2) Bolt the test adapter to the valve body and apply pressure; fluid should flow freely from the test adapter at the jack connection.

(3) Blank off the test adapter at the jack connection and gradually apply a pressure of 6,000 lb/in^2 with the unit remaining static. Leakage is not permissible. Release the pressure.

(4) With the test adapter blanked off, apply a pressure of 100 lb/in^2 at the airframe connection. Rotate each swivel joint through an angle of 180 degrees and back ten times, and through 360 degrees ten times (five clockwise and five counter-clockwise). If a swivel joint cannot be rotated through the full 360 degrees due to the obstruction of other pipes etc., it is to be rotated as far as possible. Leakage is not permissible.

(5) Repeat the test in (4), applying a pressure of 3,300 lb/in^2 and check that the torque required to rotate each swivel joint at this pressure does not exceed 25 lb. in. Release the pressure, disconnect the supply line and remove the test adapter and the blanking plug.

Note . . .

Before checking the torque, the swivels are to be 'freed' by working them to and fro approximately ten times.

(6) Complete the assembly of the unit as detailed in para. 13 (16) of the chapter.

Testing the jack unit

5. (1) With the jack in the closed position, connect the supply line of the static hydraulic test rig to the swivel connection and gradually apply a pressure of 300 lb/in^2, checking for leakage between 0 and 100 lb/in^2 and then slowly increase the pressure to 4,500 lb/in^2. Leakage is not permissible. Release the pressure and diconnect the supply line.

(2) Connect the supply line of the power pump rig to the swivel connection. Apply a pressure alternating between zero and 3,300 lb/in^2 and repeat for 200 cycles. Release the pressure and disconnect the supply line.

(3) Repeat the test in (1).

(4) With the jack fully extended and locked, operate the power pump. The pressure required to disengage the lock and fully close the jack must not exceed 150 lb/in^2 and the time required to effect the closure must not exceed 50 seconds.

(5) With the jack fully extended and the lock engaged, apply a tension load of 200 to 210 lb. at the piston rod end. Select the power pump rig control valve to supply fluid for closing the jack and apply pressure to disengage the lock and close the jack. The pressure at which this occurs must not exceed 100 lb/in^2.

(6) Release the pressure and reverse the position of the rig control valve. The jack must fully extend and the lock positively engage.

(7) Repeat operations (5) and (6) 240 times.

Note . . .

Piston rod travel need only be sufficient to ensure disengagement of the lock.

(8) Remove the tension load, operate the power pump and select the rig control valve to supply fluid to fully close the jack. With the micro-switches indicating that the locking sleeve is in the locked position, apply a pressure of 30 lb/in^2. There must be no movement of the sleeve. Release the pressure.

(9) Extend the piston rod to within 1·00 to 1·125 in. of the fully extended position and apply a tension load of 200 to 210 lb. at the rod end. The rod should move slowly to the fully extended position and positively lock.

(10) Remove the tension load, operate the power pump and select the rig control valve to fully close the jack. Apply a tension load of 200 to 210 lb. at the piston rod end. The rod should move slowly to the fully extended position and positively lock.

(11) Remove the tension load, operate the power pump and select the rig control valve to fully close the jack. Apply a tension load of 100 lb. at the piston rod end. The rod should move slowly to the fully extended position but the lock need not engage.

Installation

6. When installing the jack in the aircraft, the eye-bolt is to be adjusted to suit the pick-up points. The pin centre dimension of the jack in the extended position must not be adjusted outside the limits of 56·8 to 57·2 in. The pin centre of the eye-bolt should not be less than 1·07 in. from the adjacent face of the lock nut. The travel is 23·29 to 23·35 in. After adjustment, tighten the lock-nut against the spanner grip and wire-lock the eye-bolt, the lock-nut and the spanner grip together. Wire-lock the bleeder screw to the adapter.

7. Unscrew the filter and pour approximately 7 in^3. of oil, OM–15 (34B/9100572) into the cylinder. Replace the filter and wire-lock it to the cylinder.

Appendix 2 MAIN UNDERCARRIAGE JACK

Type No. ◀1.02347.012▶
1.00473.002

Introduction

1. The units covered in this appendix are similar to the type described in the chapter, but differs in the fitment of a re-designed travel stop to give increased spring loading on the locking sleeve, and by a change of material in the backing ring of the locking sleeve to improve low temperature performance. ◀Type 1.02347.012 differs from Type 1.00473.002 by the fitment of three split rings to the piston head.▶

TEST SCHEDULE

Test equipment

2. A static hydraulic test rig and a power pump rig fitted with a pump capable of delivering 3·45 gal. per minute are required, together with a test plug Part No. 4.60001.347 illustrated in fig. 1 of this appendix, and a supply of compressed nitrogen. All pipes between the test rigs and the jack are to be ⅜ in. outside diameter for metal pipes or ⅜ in. nominal for flexible hose. The micro-switches should be wired to a suitable electrical circuit to give visual indication by lights of the correct functioning of the locking mechanism. Before testing, the jack is to be hydraulically operated at least six times to expel all air.

3. For testing the swivel pipe unit, a test adapter Part No. 4.60001.240 and a test valve Part No. 4.60001.241 will be required.

Testing the restrictor valve and swivel pipe unit

4. (1) Remove the restrictor valve from the body and fit the test valve. Connect the supply line of the static hydraulic test rig to the airframe connection and gradually apply a pressure of 3300 lbf/in^2 . Leakage at the jack connection must not exceed 1·85 c.c. per minute. Release the pressure, remove the test valve and replace the original valve.

(2) Bolt the test adapter to the valve body and apply pressure; fluid should flow freely from the test adapter at the jack connection.

(3) Blank off the test adapter at the jack connection and gradually apply a pressure of 6000 lbf/in^2 with the unit remaining static. Leakage is not permissible. Release the pressure.

(4) With the test adapter blanked off, apply a pressure of 100 lbf/in^2 at the airframe connection. Rotate each swivel joint through an angle of 180 degrees and back ten times, and through 360 degrees ten times (five clockwise and five anti-clockwise). If a swivel joint cannot be rotated through the full 360 degrees due to the obstruction of other pipes etc., it is to be rotated as far as possible. Leakage is not permissible.

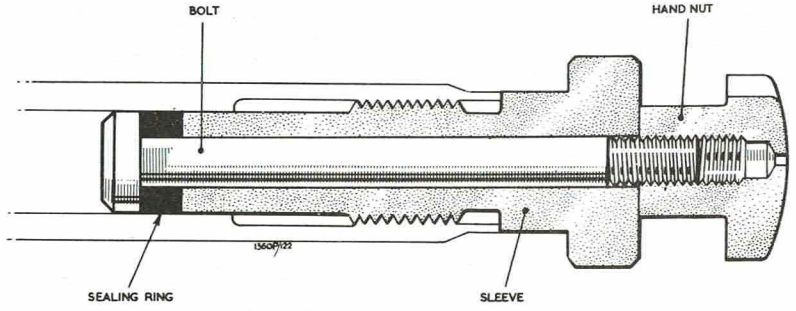

Fig. 1 Test plug

(5) Repeat the test in (4), applying a pressure of 3300 lbf/in^2 and check that the torque required to rotate each swivel joint at this pressure does not exceed 23 lbf.in. Release the pressure, disconnect the supply line and remove the test adapter and the blanking plug.

Note . . .

Before checking the torque, the swivels are to be 'freed' by working them to and fro approximately ten times.

(6) Complete the assembly of the unit as detailed in para. 13 (17) of the chapter.

Testing the jack unit

5. (1) With the jack in the closed position, connect the supply line of the static hydraulic test rig to the swivel connection and gradually apply a pressure of 300 lbf/in^2, checking for leakage between 0 and 100 lbf/in^2 and then slowly increase the pressure to 4500 lbf/in^2. Leakage is not permissible. Release the pressure and disconnect the supply line.

(2) Connect the supply line of the power pump rig to the swivel connection. Apply a pressure alternating between zero and 3300 lbf/in^2 and repeat for 200 cycles. Release the pressure and disconnect the supply line.

(3) Repeat the test in (1).

(4) With the jack fully extended and the lock engaged, operate the power pump applying a pressure of 300 lbf/in^2. The lock should disengage and the piston rod commence to retract. Allow the rod to retract 1·00 to 1·25 in. from the extended position, and then release the pressure and reverse the position of the rig control valve.

(5) Apply a tension load of 280 to 290 lb. to the end of the piston rod, and the rod should fully extend and lock.

(6) Repeat operations (4) and (5) 240 times.

(7) Remove the tension load, operate the power pump and select the rig control valve to supply fluid to fully close the jack. Apply a tension load of 100 to 105 lb. to the piston rod end; the rod should move slowly to the fully extended position, but the lock need not engage.

(8) Remove the tension load, operate the power pump and select the rig control valve to fully close the jack. With the micro-switches indicating that the locking sleeve is in the locked position, apply a pressure of 30 lbf/in^2. There must be no movement of the sleeve. Release the pressure and stop the power pump.

(9) Remove the eye-bolt and spanner grip from the piston rod and blank off the bore in the rod with the test plug as follows, referring also to fig. 1 of this appendix. If necessary, screw out the hand nut several turns to release pressure on the sealing ring and to allow for insertion of the ring in the bore. Insert the plug and screw the sleeve tightly into the rod. Then screw down the hand nut to draw up the bolt; this will compress and extrude the sealing ring to form an effective seal in the bore.

(10) Unscrew the filter from the cylinder and screw the nitrogen supply line into the filter tapping. Connect a pressure gauge and a suitable stop valve to the swivel connection. The stop valve is to be capable of controlling the release of pressure as required.

(11) With the jack fully closed, connect the static test rig supply line to the stop valve and apply a pressure 3000 lbf/in^2. Maintain this pressure. Apply nitrogen pressure up to 400 lbf/in^2 to extend the piston rod against fluid pressure. Open the stop valve to control the release of fluid pressure to a minimum of 250 lbf/in^2 during rod extension. When the piston rod is fully extended allow the fluid pressure to fall slowly, until at a pressure approaching 50 lbf/in^2, the locking sleeve should move and the lock engage. This will be indicated by the micro-switches.

(12) Disconnect the test rig supply line, remove the test plug and replace the eye-bolt securing it with the spanner

grip and lock-nut. Disconnect the nitrogen supply line and replace the filter. The filter will be finally locked on installation of the jack in the aircraft.

Installation

6. When installing the jack in the aircraft, the eye-bolt is to be adjusted to suit the pick-up points. The pin centre dimension of the jack in the extended position must not be adjusted outside the limits of 56·8 to 57·2 in. The pin centre of the eye-bolt should not be less than 1·07 in. from the adjacent face of the lock-nut. The travel is 23·29 to 23·35 in. After adjustment, tighten the lock-nut against the spanner grip and wire-lock the eye-bolt, the lock-nut and the spanner grip together. Wire-lock the bleeder screw to the adapter.

7. Unscrew the filter and pour approximately 7 in^3. of oil, OM-15 (34B/9100572) into the cylinder. Replace the filter and wire-lock it to the cylinder.

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