

## Chapter 15

### DIVE BRAKE GEARBOX

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#### DESCRIPTION

1. The dive-brake gearbox transmits through a train of gears and a plate clutch, the power of the operating motor to the dive-brake torque tubes. It also rotates a drum assembly on which cam-operated micro-switches are set to shut off the motor and apply a brake when the selected dive brake position has been reached. The gearbox is

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controlled electrically from a lever on the left-hand side of the pilots' control pedestal. The lever has two positions: BRAKES IN and BRAKES OUT. For wiring instructions and circuit functioning see Sect. 5. The driving motor (with its clutch and brake) and the microswitches, are dealt with in A.P.4343B.

2. The unit casing is in two sections; the motor-end half-casing and the switch-drum

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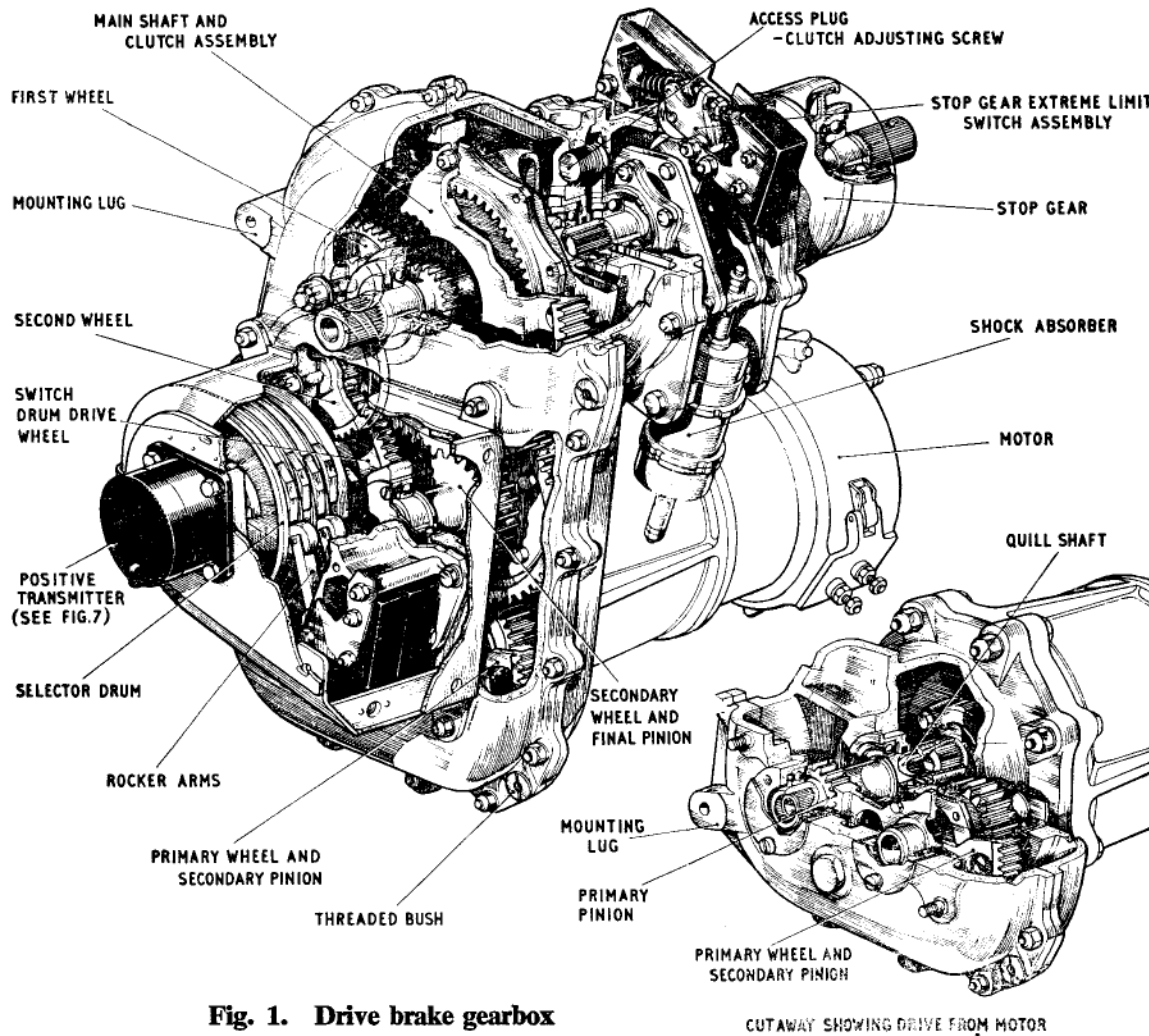
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end half-casing. Fitted to the switch-drum end is a transmitter, operated by a transmitter cam on the drum drive shaft, and connected to a dive-brake position indicator mounted on the pilots' instrument centre panel. The motor assembly incorporates a clutch and brake; it is bolted to the half-casing and drives the primary pinion through a quill shaft. The drive is taken through the

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**Fig. 1. Drive brake gearbox**

primary wheel and secondary pinion to the final pinion and main shaft wheel. The plate clutch assembly is bolted to the main shaft wheel.

3. The switch drum is operated through a train of gears, by a pinion on the main shaft, and the extreme-limit stop by a splined collar which travels along an extension of the main shaft and (when it reaches the end of its travel) causes a microswitch to be tripped.

**Primary wheel and secondary pinion**  
(fig. 1 and 6)

4. These are bolted together and their short shafts are machined to fit into ball bearings housed in the casing. The apertures in the casing are closed by detachable cover plates. The primary wheel meshes with the motor-driven primary pinion, and the secondary pinion meshes with the secondary wheel of the next assembly. The drive from the motor

is transferred to the primary pinion by a quill shaft which is splined to engage with splines in the bore of the pinion.

**Secondary wheel and final pinion**  
(fig. 1 and 6)

5. These are bolted together and housed in a manner similar to the previous assembly. The final pinion meshes with the main-shaft wheel of the clutch assembly.

**Selector drum drive** (fig. 1)

6. This is the two-stage drive between the main shaft and the selector drum. Each stage consists of a pair of wheels bushed and mounted on a bolt which passes through the wall of a casing to be secured by a slotted nut and split pin. The second stage meshes with the switch drum drive wheel which is bolted to the shaft on which the selector drum is mounted.

**Plate clutch** (fig. 5)

7. The clutch consists of a plate assembly mounted on the main shaft and encased in a housing which is bolted to the main shaft wheel. The bore of the housing is splined to locate the eight outer clutch plates, and splines on the shaft form a mounting for the seven inner plates. The clutch plates are kept in contact by eighteen coil springs retained between a backing ring and a spring-locating plate; the compression in the springs can be varied by three adjusting screws.

8. The main shaft is rotated through frictional contact between the clutch plates. One end of the shaft is splined externally to mesh with the dive-brake operating torque tube and the other end internally to drive the extreme limit stop-gear shaft. A pinion machined integral with the main shaft drives the switch drum through a train of gears. The shaft is supported at each end by ball bearings housed in the casing walls.

**Normal limit switch gear** (fig. 7)

9. The normal limit switch gear, comprising the switch-operating drum and microswitch

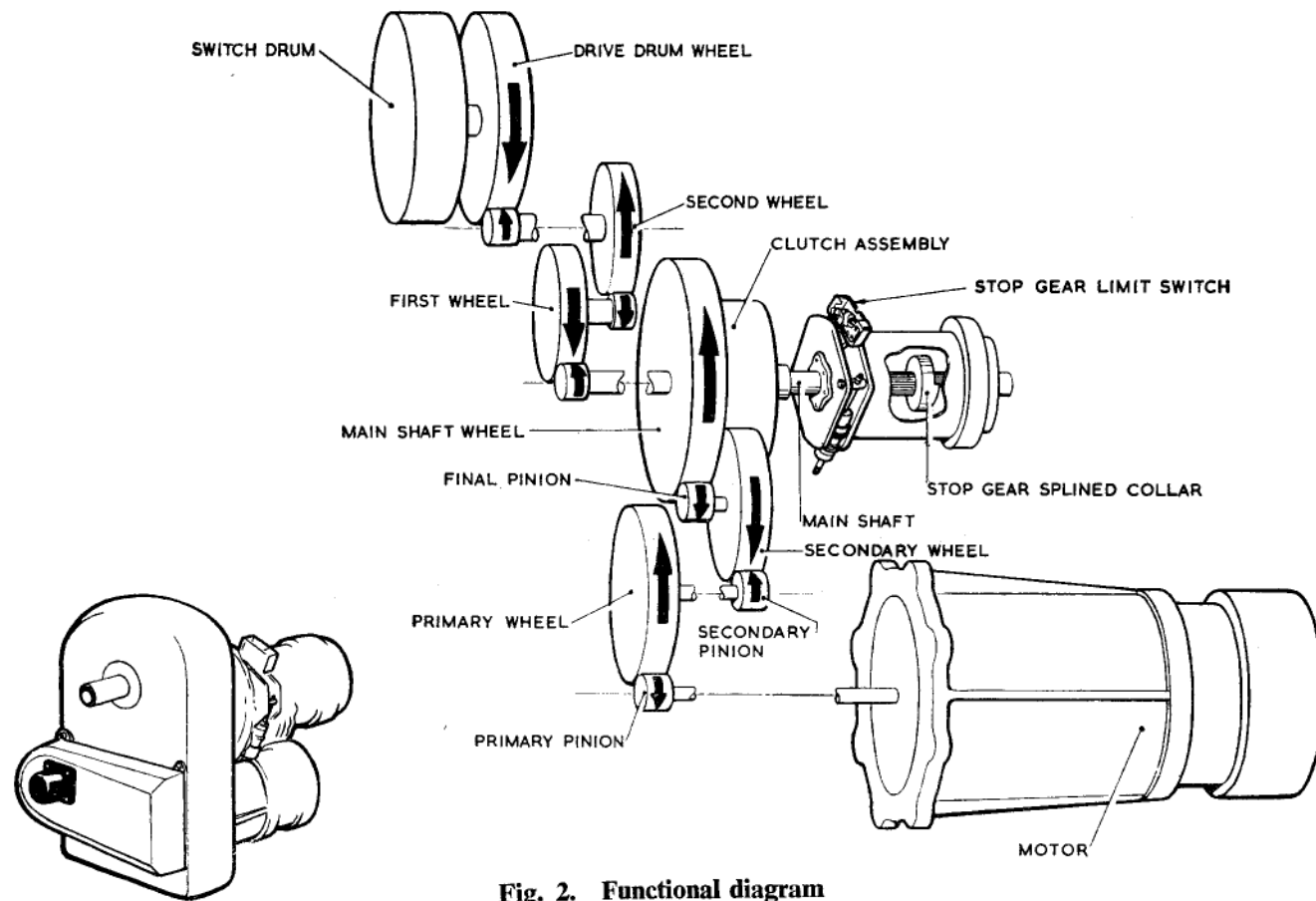


Fig. 2. Functional diagram

assembly gear, is housed in a light alloy cover assembly of three sections; the assembly is bolted to the casing. The drum is rotated so that, when the limit of dive brake travel is reached in either direction, the appropriate limit microswitches are operated to switch off the motor and apply the brake.

10. The drum consists of a cylinder mounted on a shaft which also carries the drum-drive wheel and the transmitter operating

cam (fig. 7). The shaft runs in two ball bearings mounted in a housing secured in the casing by a ring nut. Four parallel grooves are machined around the drum outer surface to house the switch-operating cams. Each cam is curved to the contour of the groove and is secured by a stud which passes into the drum through a slot in the groove.

11. The microswitch assembly (fig. 7) comprises a bracket bolted to the casing to form

a mounting for two pairs of microswitches and their pivoted operating rocker arms. Each arm trips its switch when a roller at its end contacts a cam on the rotating drum. A designation plate on the bracket is marked IN and OUT to differentiate between the pairs of switches. A setscrew in each rocker arm provides adjustment for the rocker arm-to-switch contact.

#### Extreme limit stop-gear (fig. 4)

12. The extreme limit stop-gear assembly provides the method of cutting off current to the operating motor, through the extreme limit switches, in the event of failure of the normal limit switches, and absorbing the acceleration loads applied. The assembly, enclosed in a casing made in two sections, is bolted to the motor-end casing and is driven by the friction clutch through the main shaft, external splines on one end of the stop-gear shaft meshing with splines in the bore of the main shaft.

13. The stop-gear shaft is externally splined along most of its length and carries an internally threaded splined collar which travels to and fro on the shaft by reason of its engagement with the threaded barrel enclosing the shaft. Each end of the barrel is sealed by an end plate that forms a housing for the ball bearings in which the shaft rotates. Machined dogs on the inner faces of the end plates correspond with similar dogs on the faces of the collar.

14. A pair of levers mounted to the barrel are attached to the two shock-absorber units and form a mounting for the cam which contacts the roller of the switch-tripping mechanism. Each shock-absorber unit consists of two springs enclosed in a cylinder through which runs a central spindle. A guide at each end of the cylinder compresses the spring according to the direction of the load applied.

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15. The extreme-limit microswitch and its operating mechanism is mounted on a bracket bolted to the main casing. The tripping mechanism consists of a pivoted arm carrying an adjustable screw which contacts the switch and a roller which is set to protrude into a slot in the stop-gear casing, where it can ride the cam on the levers on the barrel. A return spring fixed between the mechanism and its mounting bracket, keeps the roller in contact with the cam.

**Position transmitter (fig. 7)**

16. Fitted to the switch drum end casing, the transmitter is operated by a cam (9) keyed to the drum-drive shaft riding on the transmitter roller arm (33). The transmitter is connected to the dive brake indicator, mounted on the pilots' instrument centre panel, indicating the dive brakes IN or OUT position.

**Operation**

17. The electric motor drives a train of gears designed to reduce the rotational speed of the motor to a shaft speed suitable for direct operation of the dive brakes. The gearbox is mounted laterally in the fuselage so that the ends of the mainshaft can be connected to the dive brake operating torque

**Lubrication**

21. All gears and moving parts must be freely smeared with grease XG-275 during assembly. This does not apply inside the clutch casing or inside the quill shaft coupling housing, where the parts MUST be kept free from grease.

**Hand winding tool**

21A. A hand winding tool (Table 2) provides a means of rotating the gears independently of the electric motor and thus facilitates the setting of the cams. To use the tool the motor is removed and the winding tool spigot (Mod. G.E.2815) engaged with the gearbox primary pinion quill shaft.

**Clutch adjustment**

22. If the clutch slips in service, indicated

tubes through universal joints and shafts interposed between them.

18. A second train of gears rotates a drum on which cams are set to contact micro-switches controlling current to the motor and its brake. Selection of the dive-brake IN or OUT position, puts the appropriate micro-switch in circuit and switches on the motor. When the selected position has been reached the rotating cam contact on the drum will switch off the motor and de-energize the brake solenoid.

19. Should the normal switches fail, an

extreme limit microswitch, operated by the stop gear, opens the master contactor. To do this the stop-gear roller, which does not normally travel the full extent of its run, continues until it engages the dogs machined on the end plate according to the direction of travel. This causes the barrel to turn and so operate the extreme limit switch, through the cam and roller contact and applying the load to the shock absorbers through the levers.

20. The plate clutch is set to slip should failure of the dive-brake mechanism apply excessive loads to the gearbox.

**TABLE 1**  
**Functional data**

Description	Data
Gear ratio, motor to main shaft ... ..	28 : 1
Gear ratio, main shaft to switch drum ... ..	24.4 : 1
Operational time, dive brakes IN to OUT ... ..	4 sec.
Operational time, dive brakes OUT to IN ... ..	less than 4 sec.
Torque of main shaft, per side ... ..	69 lb.ft. } Normal
R.P.M. of main shaft ... ..	285 } continuous
R.P.M. of motor ... ..	8,000 } running

**SERVICING**

by failure of the dive brakes to open fully *in flight*, adjustment is necessary as follows :—

- (1) Remove the motor (*para.* 26) and rotate the primary shaft in a clockwise direction until the OUT switches trip.
- (2) Remove the bolt securing the universal joint to the gearbox drive on the starboard side.
- (3) Remove the bolts at the opposite end of the torque tube, and slide the tube outboard over the sleeve until the universal joint disengages the splines on the gearbox shaft.
- (4) Disconnect the electrical cables from the microswitch (*fig.* 4).
- (5) Remove the stop gear and shock absorbers (*fig.* 4).
- (6) Replace in the torque tube the bolts removed in operation (3).
- (7) Refit the motor.
- (8) Remove the three plugs and washers to gain access to the adjuster screws.
- (9) Turn the three adjuster screws (*fig.* 6) evenly until the clutch slips when a torque of 3,000 to 3,500 lb. is applied to the main shaft in both directions, using a torque spanner; a torque spanner

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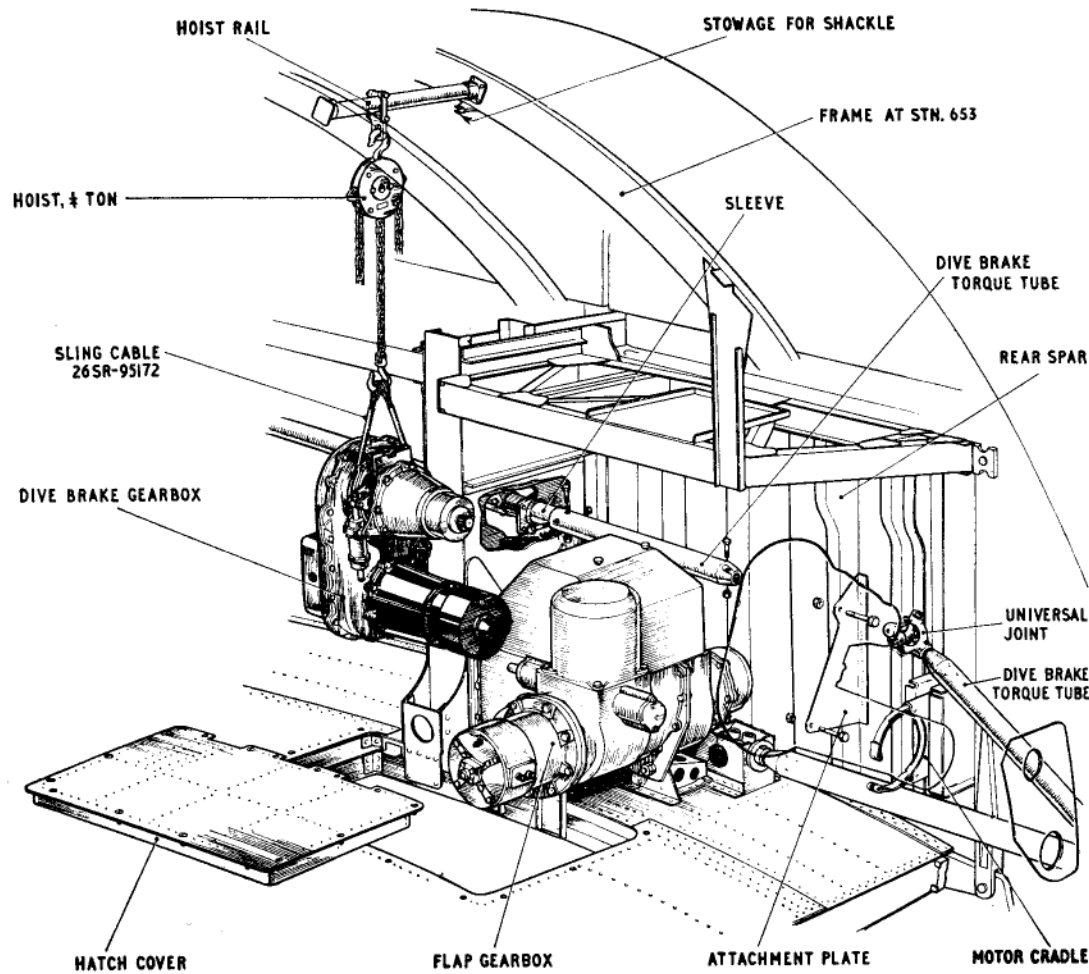


Fig. 3. Gearbox removal

adapter (Table 2) is provided to fit the stop-gear end of the shaft.

- (10) Replace the three plugs and washers (fig. 6) removed in operation (8).
- (11) Refit the stop gear and shock absorbers as instructed in para. 41, operations (15) to (19).

- (12) Re-connect the electrical cables to the microswitch.

**Note . . .**

*In order to obviate resetting the switches, ensure that the splined shaft of the stop gear and of the gearbox are reassembled exactly as before separation.*

**Cam setting**

23. On completion of the adjustments outlined in para. 22 the cams on the switch drum are to be set to the normal limit switches at the positions indicated as follows:—

IN switches to TRIP  $25 \begin{smallmatrix} +2 \\ -0 \end{smallmatrix}$  motor shaft turns before the stop gear faces meet.

OUT switches to TRIP  $25 \begin{smallmatrix} +2 \\ -0 \end{smallmatrix}$  motor shaft turns before the stop gear faces meet.

24. The IN and OUT pairs of microswitches are connected in series and on final adjustment the operating cams should be set as near as possible to the point where both switches "trip" simultaneously when the actuator reaches either end of its travel.

**Note . . .**

*If after completing this adjustment the switch gear assembly is removed from the gearbox for any reason whatever, the cam setting must be rechecked before the gearbox is operated.*

**Position transmitter setting (fig. 7)**

25. With the dive brakes IN proceed as follows:—

- (1) Loosen the cover top plate retaining bolts and slide the plate (3) backwards or forwards until the position of the indicator needle coincides with the IN line, then tighten the bolts.
- (2) Motor the dive brakes to OUT and check that the indicator reads OUT. (It is intended that this reading shall be only approximate).
- (3) Motor the dive brakes to IN and re-check the indicator at the IN position.

**Note . . .**

*If necessary, the indicator needle movement may be increased by shortening the length of the roller arm (33).*

## REMOVAL AND REFITTING

### Motor (fig. 1)

26. To remove the motor proceed as follows:—

- (1) Disconnect the electrical leads, and the band of the motor cradle (fig. 3).
- (2) Remove the bolts securing the motor to the gearbox and withdraw the motor from the splined drive shaft.

### Gearbox (fig. 3)

27. To remove the gearbox proceed as follows:—

- (1) Disconnect the electrical leads to the

motor and release the motor cradle band.

- (2) Remove the bolt securing the port torque tube to the drive shaft and the bolts in the sleeve at the opposite end.
- (3) Slide the tube along the sleeve.
- (4) Remove the bolt securing the universal joint to the gearbox drive on the starboard side.
- (5) Remove the bolts securing the gearbox to the structure.
- (6) Support the starboard torque tube and slide the gearbox inboard to disengage the shaft.

- (7) Manhandle the gearbox to a position just aft of the access hatch in the bomb bay roof, attach the sling, and lower the gearbox through the access hatch.

### Installation requirements

28. Refitting the motor and gearbox assemblies to the aircraft is a reversal of the sequence detailed in para. 26 and 27 with the following requirements:—

- (1) Do not remove the switchgear assembly when wiring in to the aircraft.
- (2) The dive brakes must be set in accordance with Sect. 3, Chap. 4.

## DISMANTLING

### Equipment

29. The special tools required for dismantling, reconditioning and reassembling the gearbox, with their application, are listed in Table 2.

### Gearbox

30. To dismantle the gearbox reverse the sequence of assembly instructions (para. 40).

### Note . . .

To facilitate dismantling, four bushes (fig. 1), into which 2 B.A. bolts can be screwed to force the halves of the casing apart, are incorporated in the switch-drum half casing.

### Motor

31. Dismantling, reconditioning, repair and reassembly of the driving motor with its integral brake and clutch is covered in A.P. 4343B.

### Extreme limit stop gear (fig. 4)

32. To dismantle the gear, proceed as follows:—

- (1) Remove the shock absorbers (28) by unscrewing the trunnion bolts (27) and the nuts from the top ends of the spindles.
- (2) Remove the extreme limit switch gear by unscrewing the bolts securing the bracket to the casing.
- (3) Remove the locating plate (17) and withdraw the lever and barrel assembly from the casing.
- (4) Remove the securing bolts and withdraw the inner end plate (14) complete with ball bearing.
- (5) Remove the securing bolts and withdraw the levers (6) complete with their pivots (16).
- (6) Remove the circlip (2), ball bearing (33) and circlips (34).

- (7) Unscrew the collar (31) from the barrel (5) and withdraw it from the shaft (1).
- (8) Remove the bolts securing the outer end plate (3) to the barrel (5).

### Plate clutch (fig. 5)

33. To dismantle the plate clutch, proceed as follows:—

- (1) Loosen the three adjuster screws (5) to relieve compression on the springs (4).
- (2) Remove the bolts securing the main shaft wheel (13) to the clutch housing.
- (3) Withdraw the main shaft (12) complete with the seven inner (3) and eight outer (11) clutch plates.

### Note . . .

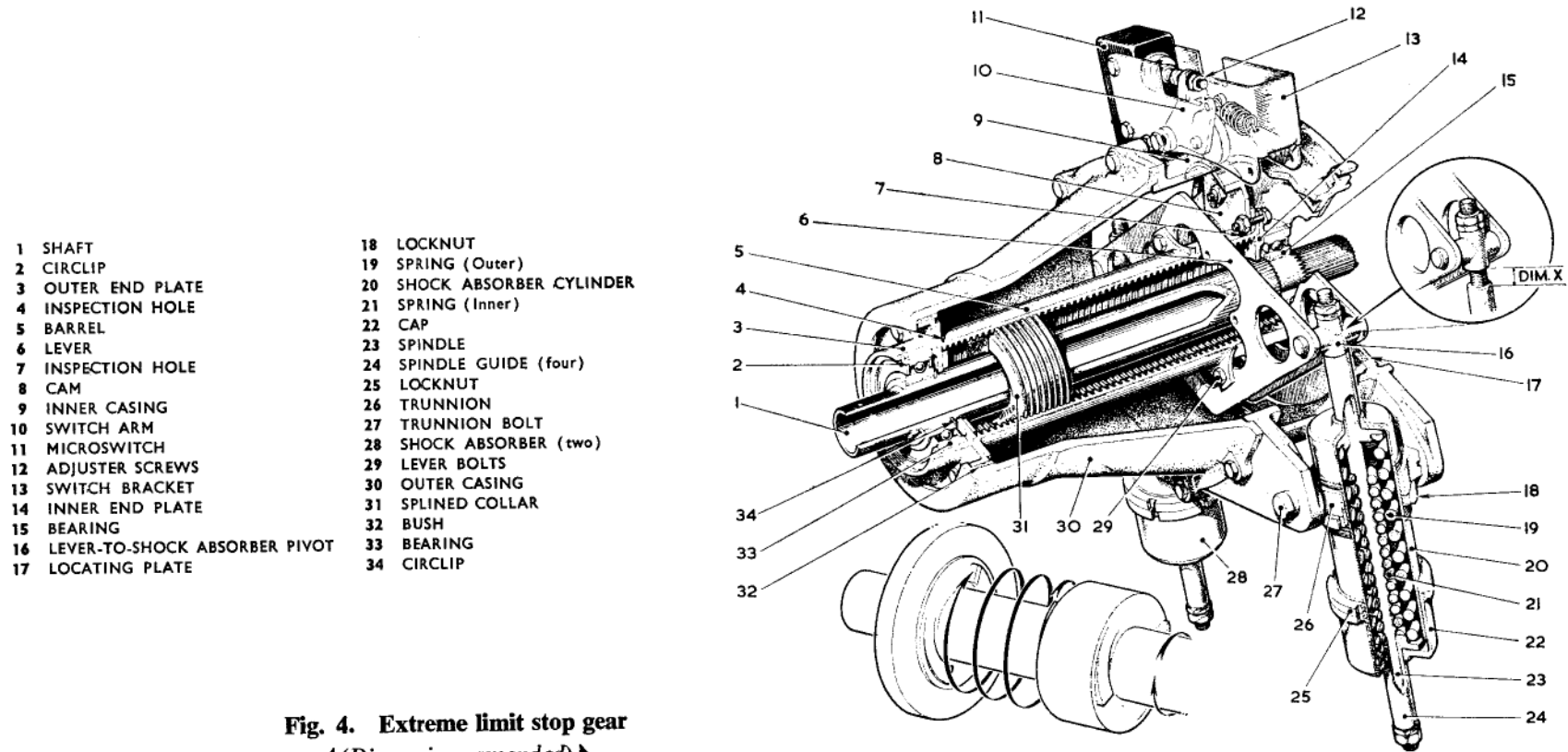
On reassembly, the individual plates must be replaced in their original relative positions.

- (4) Withdraw the backing ring (10), springs (4) and locating plate (9).

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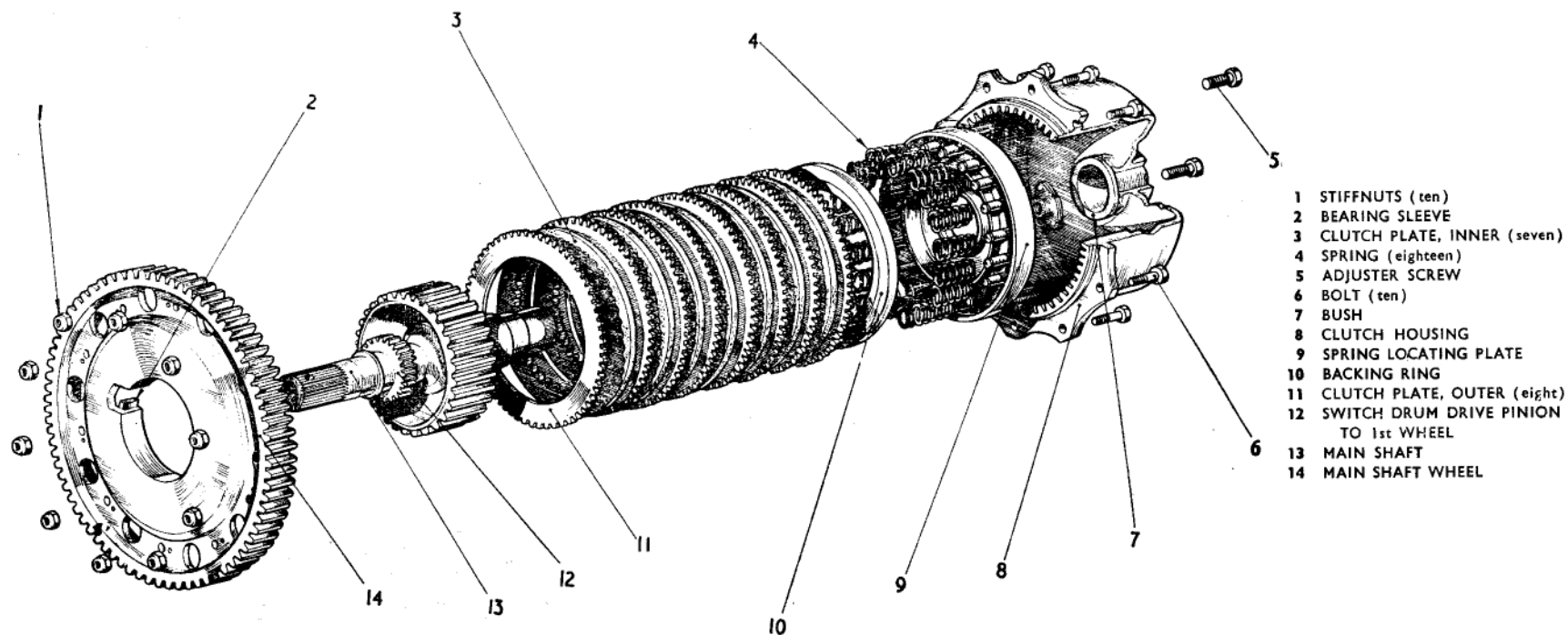
**TABLE 2**  
**Special tools**

Ref. No.	Part No.	Description	No. Off	Application
26SR/95166	67479/1671	Spanner "C"	1	Switch-drum bearing nut
	67479/1669	Spanner, "C"	1	Switch-drum bearing housing
26SR/95170	67479/1673	Spanner, "C"	2	Shock-absorber locknut
	67479/1723	Adapter, torque spanner	1	Setting clutch torque
	67479/7709	Tool, hand winding	1	Setting cams, without rotating motor
	67479/1617	Gearbox sling cable	1	Gearbox removal



**Fig. 4. Extreme limit stop gear**  
◀ (Dimension amended) ▶

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**Fig. 5. Assembly of clutch**

### RECONDITIONING

#### Inspection and rectification

34. At the reconditioning period specified in the Servicing Schedule, the gearbox must be removed from the aircraft and completely stripped down, its mechanical parts washed in a bath of trichlorethylene (Ref. No. 33C/547 or 836) and a thorough check made for wear and corrosion. The latter may be cleaned off and the part accepted provided that pitting is not excessive (*para.* 37).

35. Threads of bolts, studs, and setscrews must be examined for signs of damage or over-stressing and the studs tested for security. Inspect the gear trains and the ball bearings in accordance with A.P.880C and A.P.1464B respectively.

36. Where cracks are suspected in the casing, gears, or other parts, detection tests must be made in accordance with A.P.880C.

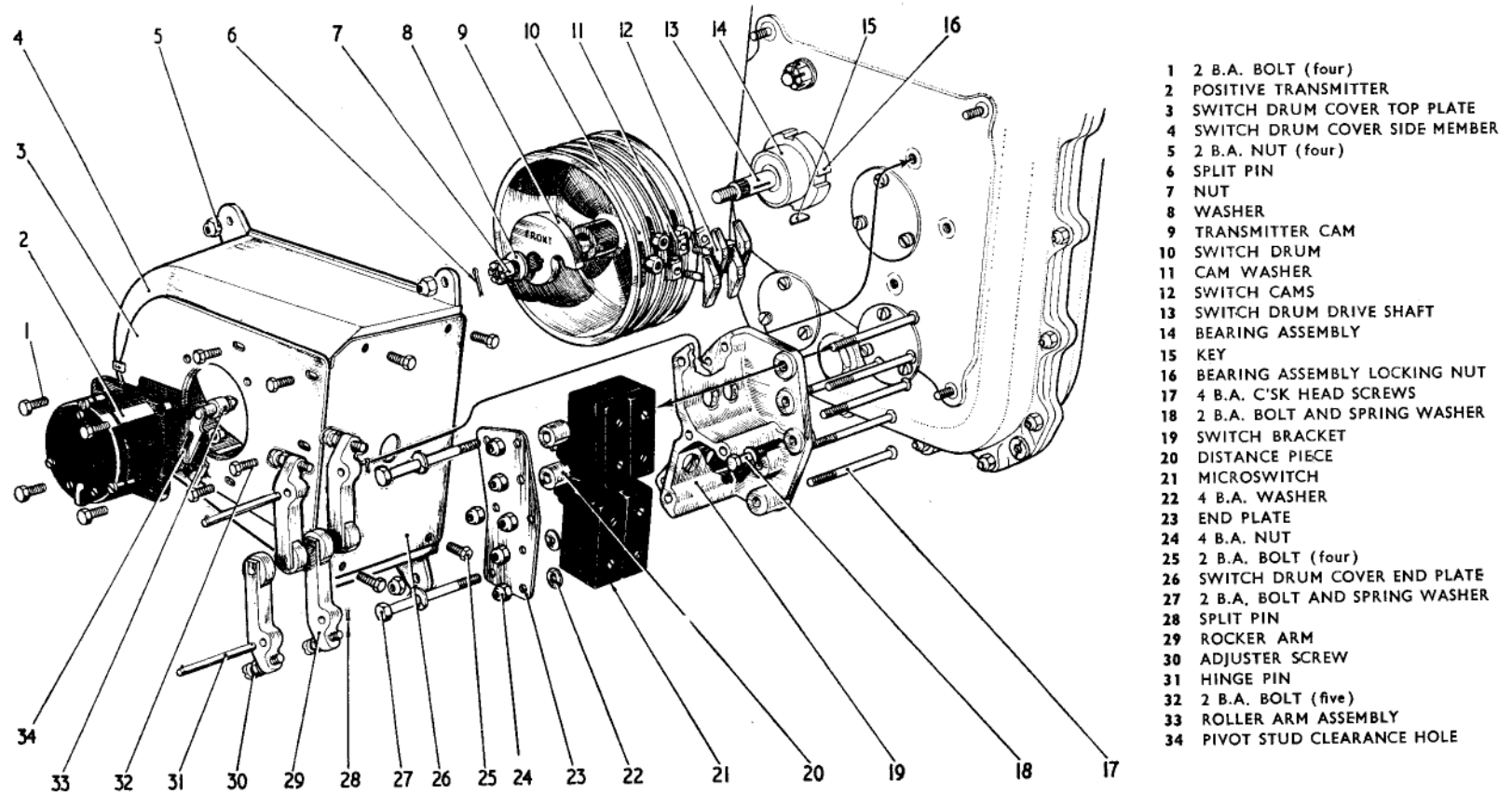
37. If the metal clutch plates are scored, or

the asbestos plates worn to less than three-quarters of their original thickness ( $0.11 \pm 0 - 0.002$  in.), they must be renewed.

#### Corrosion

38. Where the protective coating has been removed from the casing, or where corrosion occurs, the area must be treated in accordance with the instructions contained in A.P.880B, Vol. 1, Sect. 4, Chap. 8.

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**Fig. 7. Assembly of normal limit switch gear**

(b) (fig. 4) Rotate the stop gear shaft (1) until the collar (31) is just in contact with the dogs on the outer end plate (3).

(c) (fig. 4) With both assemblies set in this manner, enter the stop gear shaft (1) into the bore of the main shaft. If, however, the splines do not coincide, rotate the stop gear shaft (1) to withdraw

the collar (31) from contact with the stop face on the outer end plate (3) until they mesh correctly. Bolt the assemblies together.

(16) (fig. 4) Rotate the motor quill shaft in a counter-clockwise direction until the collar (31) is just in contact with the dogs on the inner end plate (14).

(17) In this position the microswitch IN cams should just operate their microswitches. If not, reset microswitches to suit.

(18) Set the stop-gear microswitch as follows:—

(a) (fig. 4) Engage the winding handle in the motor quill shaft and turn in either direction until the shock-

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absorber trunnions show 0.2 in. movement (fig. 4, dim. X). ▶

(b) (fig. 4) With the unit held at this setting, turn the adjuster screw (12) towards the switch plunger until the switch trips. Turn the screw a further half-turn towards the plunger, and lock.

(c) Release the winding handle and allow the stop gear to return to the central position. Check the operation of the switch in both directions; the switch must 'make' at  $0.2 \begin{smallmatrix} +0.05 \\ -0.0 \end{smallmatrix}$  in. and break at  $0.2 \begin{smallmatrix} +0.0 \\ -0.05 \end{smallmatrix}$  in. for both stop gear positions, these dimensions being trunnion movement (fig. 4, dim. X). ▶

(19) Refit the motor and connect the switch cables.

(20) Set the position of the two pairs (IN and OUT) of switch operating cams on the drum. To do this the cams must be moved round the drum, running the motor in either direction each time an adjustment is made, until the shock-absorber levers are seen to start moving. From this position move the cams to operate the switches 0.02 in. earlier.

**Note . . .**

*This is a bench test setting. The final adjustment (para. 23) is to be made when the gearbox is installed in the aircraft.*

(21) (fig. 7) Set the gearbox switch to IN and fit the switch drum cover side member (4) complete with end plate (26) to the studs on the casing.

(22) (fig. 7) Fit the position transmitter to the switch drum cover top plate (3) with four bolts to the top plate anchor nuts.

(23) (fig. 7) Set the roller arm (33) to its longest length.

**Note . . .**

*It is necessary to provide clearance between the roller arm pivot stud and the transmitter cam when the latter is moved in both directions. To provide this clearance it may be necessary to fit a packing piece, Pt. No. 70184-259, between the positive transmitter and the switch drum cover top plate.*

(24) Attach the top plate assembly to the end plate, set to the approximate mid-position of the slotted holes and tighten the bolts.

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