

GENERAL

1. The transmission arrangement for all marks of Ferret are similar and some assemblies, eg main gearbox and transfer gearbox, are identical. Detail differences exist in bevel boxes, hub carrier and hub reduction gear between Mk 1 and 2 (including all sub-marks) and Mk 4 and 5 (Ferret 'big-wheel'). Repair techniques for different marks are detailed in appropriate paragraphs; unless otherwise stated it can be assumed that unit repairs are applicable to all marks.

FLUID FLYWHEEL

2. Unit repairs to fluid flywheel are limited to checking and topping up oil level, as detailed in User Handbook.

MAIN GEARBOX

3. General

The main gearbox is a pre-selective type, comprising a compound epicyclic gear train to provide five speeds. Each gear ratio, with the exception of 5th (top) gear, is obtained by applying a brake band to lock the outer member (drum) of the selected gear. The brake band is applied when the selected strut is operated by the bus bar; 5th (top) gear, is obtained in a similar way except that the strut operates a clutch actuating ring.

4. During manufacture or base overhaul, the brake bands are adjusted to ensure that:-

- a. The operation of the bus bar and strut locks the drum of the selected gear train.
- b. Normal wear of the bands will be compensated by automatic adjustment when gear changes are made.

5. In addition and to provide for wear in excess of normal or to correct minor maladjustments, a 'pedal up' procedure is detailed in User Handbook. It is ESSENTIAL that 'pedal up' procedure is carried out before adjustments are made. If, despite 'pedal up' procedure having been carried out, there is a tendency for any gear to slip or 'kick-back' (the condition when the bus bar goes over centre) when gear pedal is operated, proceed as detailed in para 6-10.

6. Access

To adjust the gearbox and control linkage, remove the following items:-

- a. Wireless.
- b. Wireless platform.
- c. Gunners seat.
- d. Transmission cover.
- e. Gearbox inspection cover.

7. Gear change pedal

To ensure maximum pressure is applied by the bands to outer member (drum) of selected gear, there must be free movement of gear change pedal. To check and adjust free movement, proceed as follows:-

- a. Select 1st gear and operate pedal.
- b. With 1st gear engaged there should be 1/2 in. free travel of gear change pedal. Should this free travel be incorrect, proceed as follows:-
 - (1) Engage neutral position of gearbox.
 - (2) Disconnect actuating rod.
 - (3) Adjust length of actuating rod to obtain 1/2 in. free travel.
- c. Road test vehicle for gear 'slip' or 'kick back' if any adjustment has been made.
- d. If 'slip' or 'kick back' still exists proceed as detailed in para 8.

8. Automatic adjuster nut, see Fig 2

To check that automatic adjuster mechanism of a faulty gear is functioning correctly, proceed as follows:-

- a. Ensure 'pedal up' procedure is carried out.
- b. Remove items listed in para 6.

Note: Before proceeding with any of the following adjustments, ensure that pull rods are NOT level with or protruding through any adjuster nut. If this condition is present the brake band is either worn out or broken and gearbox will require major repairs.

- c. Remove adjuster spring and mark a line on top of adjuster nut coincident with another on retaining pedestal of adjuster table.
- d. Turn adjuster nut quarter turn anti-clockwise and refit spring.
- e. Select adjusted gear and 'pedal up'; observe that adjusting ring strikes stop screw and that adjuster nut is turning. When adjustment is completed (ie nut has ceased to turn) prescribed lines should once again be coincident. If not, examine adjuster mechanism; ensure cone seating is free from burrs and adjuster nut can be freely rotated by hand.

Note: Adjuster nuts may be removed from all pull rods excepting 5th (top) gear. Do NOT remove 5th gear adjuster nut otherwise pull rod will drop to bottom of gearbox.

- f. If adjuster nut fails to rotate correctly after free movement has been ascertained, a defective spring is indicated and must be changed.

g. In the event of adjusting ring NOT contacting stop screw, carry out procedure detailed for adjusting brake bands.

h. If gear 'slip' or 'kick back' occurs after checking adjuster mechanism, continue as detailed in para 9.

9. Adjusting brake bands

Adjustments to ensure the correct bus bar height (dimension 'X' on Fig 3) are obtained by screwing the stop screw in or out. To raise the bus bar, ie decrease the 'X' dimensions, the stop screw must be screwed in. Conversely to lower bus bar, stop screw must be screwed out. Checking and adjusting must be accurately carried out as follows:-

a. Select and engage gear to be adjusted.

b. Using gauge, LV9 ASC FV55522 positioned between 4th and 5th gear as shown in Fig 4, check bus bar height. If incorrect, select neutral and slacken locknut; turn stop screw in appropriate direction and tighten locknut. Remove spring, unscrew adjuster nut a half turn and refit spring.

c. Re-select gear to be adjusted and 'pedal up' until adjuster nut ceases to turn. Recheck bus bar height and repeat adjusting procedure as necessary until dimension 'X' is correct.

10. 'Over centre' adjusting

In an emergency, eg measuring gauge is not available, the 'over centre' method of adjusting can be used as follows:-

a. Remove adjuster spring.

b. Select and engage gear.

c. Unscrew adjuster nut while operating gear change pedal until noticeable 'kick back' is felt at pedal.

d. Screw in adjuster nut a small amount at a time; operate pedal after each movement, until 'kick back' just disappears.

e. Mark a line on top of adjuster nut, coincident with another on retaining pedestal of adjuster table.

f. Turn adjuster nut quarter turn anti-clockwise and refit spring.

g. 'Pedal up' gear; observe that adjusting ring strikes stop screw and that adjuster nut is turning. When adjustment is completed, ie nut has ceased to turn, prescribed lines should once again be coincident.

h. If prescribed lines are not coincident, the stop screw must be adjusted until correct setting is obtained.

Note: If the 'over centre' method of adjustment has been used, the gearbox should be rechecked using the correct gauge at earliest opportunity.

11. Gearbox control adjustment

a. Should gear selection become difficult or unobtainable in first or third gear, examine for the following faults:-

- (1) Obstructions on the floor or hull causing jamming of rods or bell-cranks.
- (2) Bent or buckled rods.
- (3) Worn clevis pins.
- (4) Loose bolts securing selector gear bracket.

Should none of these faults be apparent, the rods must be checked and adjusted as necessary.

b. To check and adjust rods, proceed as follows (see Fig 5):-

- (1) Remove gearbox inspection cover.
- (2) Disconnect the fork from gearbox selector lever and push it down to its lowest position (first gear selected).
- (3) Depress gear change pedal as far as it will go to engage gear, release the pedal. Observe that the gear is engaging by watching the gear adjusters through the inspection aperture.
- (4) Place the selector at first gear in the gate, offer up the fork end and clevis pin to gearbox lever. If it will not engage freely, note the amount.
- (5) Pull the gearbox lever up as far as it will go (third gear selected); depress the gear change pedal to engage gear.
- (6) Place the selector at third gear in the gate, offer up the fork end and clevis pin for engagement; it should be out by the same amount as the first gear position. Adjust the rods by lengthening or shortening as necessary, refit all clevis and split pins and the gearbox inspection cover.

Note: Should second, fourth or fifth gears fail to engage after the above adjustments have been carried out, recheck brake band adjustment of these gears in accordance with para 9.

TRANSFER GEARBOX

12. General

The transfer gearbox casing is cast integral with the main gearbox, but incorporates its own lubrication system. Unit repairs to transfer gearbox are to be limited to checking and adjusting forward and reverse selector.

13. Forward and reverse selector adjustment

- a. Remove front left hand propeller shaft tunnel and transfer gearbox cowling; examine operating rod for bending or fouling, disconnect operating rod.
- b. Remove inspection cover on top of transfer gearbox and select neutral by turning the vertical shaft on left hand side of the transfer gearbox casing to bring the top operating arm in a central position; the bottom arm should now be at right angles to the top arm, if not, reposition the arm.
- c. With the gear selector in the exact mid-way position of the gate, adjust length of operating rod to allow clevis pin to pass freely through fork end and operating arm.
- d. Check movement of the gear selector by selecting forward-neutral-reverse; these positions can be felt at the gear selector when the spring-loaded ball engages the selector rod in the transfer gearbox.

PROPELLER SHAFTS AND BEVEL BOXES

14. General

Owing to the inaccessibility of propeller shafts and bevel boxes, unit repairs to these assemblies are to be limited to servicing as detailed in User Handbook.

FINAL DRIVE

15. Trunnion swivel Mk 1 to 2 and all sub-marks, see Fig 6

To check steering swivel lift, proceed as follows:-

- a. Remove road wheel and jack up hub.
- b. Remove four hexagon socket head screws from hub swivel top cap (3), remove cap and thrust pad (4).
- c. Locally manufacture and fit a mild steel dummy thrust pad of the following dimensions:-

Diameter	0.500 in.
Thickness	0.320 in.
- d. Refit swivel top cap and finger tighten the four socket screws until thrust pad makes contact with thrust button (2); contact can only be determined by friction on the screws as they are tightened. Ensure mating faces of top cap and bush housing (6) are square.
- e. Use feeler gauge to measure clearance between mating faces of top cap and bush housing.

f. To determine correct thrust pad size, subtract feeler gauge dimension from size of dummy thrust pad (0.320 in.) and subtract a further 0.002 in. to give a running clearance. Correct running clearance between thrust pad and button is 0.001 in. - 0.0025 in.

Example:-	Dummy thrust pad	=	0.320
	Feeler gauge dimension	=	0.016
			0.304
	Running clearance	=	0.002
			0.302
	Thrust pad size	=	0.302

See para 16 for thrust pad size

g. Remove swivel top cap, fit correct thrust pad and smear pad face with Grease, XG 279.

h. Refit swivel top cap and road wheel.

16. Thrust pad sizes

Thrust pads are supplied in 0.003 in. increments from 0.281 in. to 0.314 in. under Part No LV9/ASC FV 9916/1 to LV9/ASC 9916/12. See Spare Parts List and Wh Veh V 629 Misc Instr No 6.

17. Trunnion swivel, Mk 4 and 5 vehicle, see Fig 7

To check steering swivel lift, proceed as follows:-

- a. Remove road wheel and jack-up hub.
- b. Remove four hexagon socket head screws from swivel top cap.
- c. Remove shims fitted under top cap.
- d. Refit top cap and finger tighten socket head screws until friction is felt on screws. Ensure mating faces of top cap and bush housing are square and measure clearance between them, using feeler gauge.
- e. To determine correct shimming required to give running clearance for trunnion swivel, add 0.003 in. to feeler gauge dimension.
- f. Select and fit correct shimming under top cap and refit road wheel.

18. Reduction gear, Mk 1 and 2 vehicles and all sub marks. See Fig 8

The reduction gear consists of an epicyclic gear housed within the wheel hub. Dismantling is to be carried out as follows:-

- a. Remove road wheel and drain hub.
- b. Remove hub cap.

- c. Remove drive shaft nut (19) and tab washer.
- d. Remove outer bearing housing (3) (5/16 in. UNF extractor screws).
- e. Remove annulus hub reduction.
- f. Remove shims (4), sun wheel and spacer (17).
- g. Remove planet hub reduction gear.

19. Maintenance and repair

Examine and renew components as required, observing the following points:-

- a. Should the dowel holes in carrier/swivel hub show any sign of elongation, vehicle must be backloaded for field repair.
- b. Planet carrier securing bolts must be exchanged if any signs of wear or stretch exists. Only bolts of 'S' steel are to be used; (Part No G1 6306-99-941-0313).

20. Assembling

It is essential when assembling planet carrier to carrier/swivel hub that the planet carrier is tightened to correct torque against carrier/swivel hub and NOT outer roller bearing.

- a. To obtain accurate measurements for determining correct clearance (0.002-0.004 in.) between planet carrier and outer roller bearing, proceed as follows:-

(1) Refer to Fig 9 and 10.

(2) Manufacture gauge plate.

(3) Assemble gauge plate to carrier/swivel hub, tighten (10 lbf ft) the three securing bolts to pull roller bearings into position. Ensure gauge plate is clamped against bearing and not dowels. Should the plate touch the dowels undercut the inner face of plate for a depth of 0.025 in. from centre to 3.25 in. dia.

(4) With a Vernier depth gauge passing through 1/2 in. dia hole, measure distance from face of gauge plate to carrier hub. Repeat this procedure through remaining two 1/2 in. dia holes. From the average of these three measurements subtract 0.4 in. (thickness of gauge plate) and note the result; dimension 'Y'.

(5) Measure height of protrusion on rear of planet carrier, note dimension 'Z'.

(6) To obtain correct shim thickness required between planet carrier and carrier/swivel hub, subtract dimension 'Z' from dimension 'Y' and add 0.002 in., ie $(Y - Z) + 0.002 = \text{shim thickness}$. In selecting required thickness, the shims must be measured independently. If the exact thickness cannot be obtained, select shims to the next highest number.

(7) Remove gauge plate.

(8) The size and Part No of shims available for fitting between planet carrier and carrier/swivel hub are:-

0.003 in.	:	LV9/ASC FV 50971/1
0.010 in.	:	LV9/ASC FV 50971/2
0.036 in.	:	LV9/ASC FV 50971/3

b. Position selected shims (5) on carrier hub, secure and tighten planet carrier to carrier hub. Torque tighten securing bolts (16) to 25-30 lbf ft; this figure must NOT be relaxed or exceeded for any reason.

c. Fit hub reduction annulus.

d. Calculate, select and fit the required hub spacer (17) and shims (4) as follows:-

(1) See Fig 8. Measure distance 'X' with depth gauge from planet cage cover to tracta fork spline abutment (this should be between 2.130 in. and 1.940 in.), ensuring that tracta fork shaft is pushed fully home before measurements are taken.

(2) Subtract 1.800 in. from depth gauge reading.

(3) Select spacer FV 50965 to nearest size under this figure and shims FV 50966 to make up remainder.

Example:-	Depth gauge reading 'X'	=	2.016
	Subtract		1.800

0.216

Select spacer FV 50965/3	=	0.200
Select (Qty 2) shims FV 50966/1	=	0.006
shim FV 50966/2	=	0.010

Total 0.216

Note: When fitted and assembled, spacer abuts the shoulder at splined end of tracta fork shaft and shims are positioned between sun wheel and ball bearing.

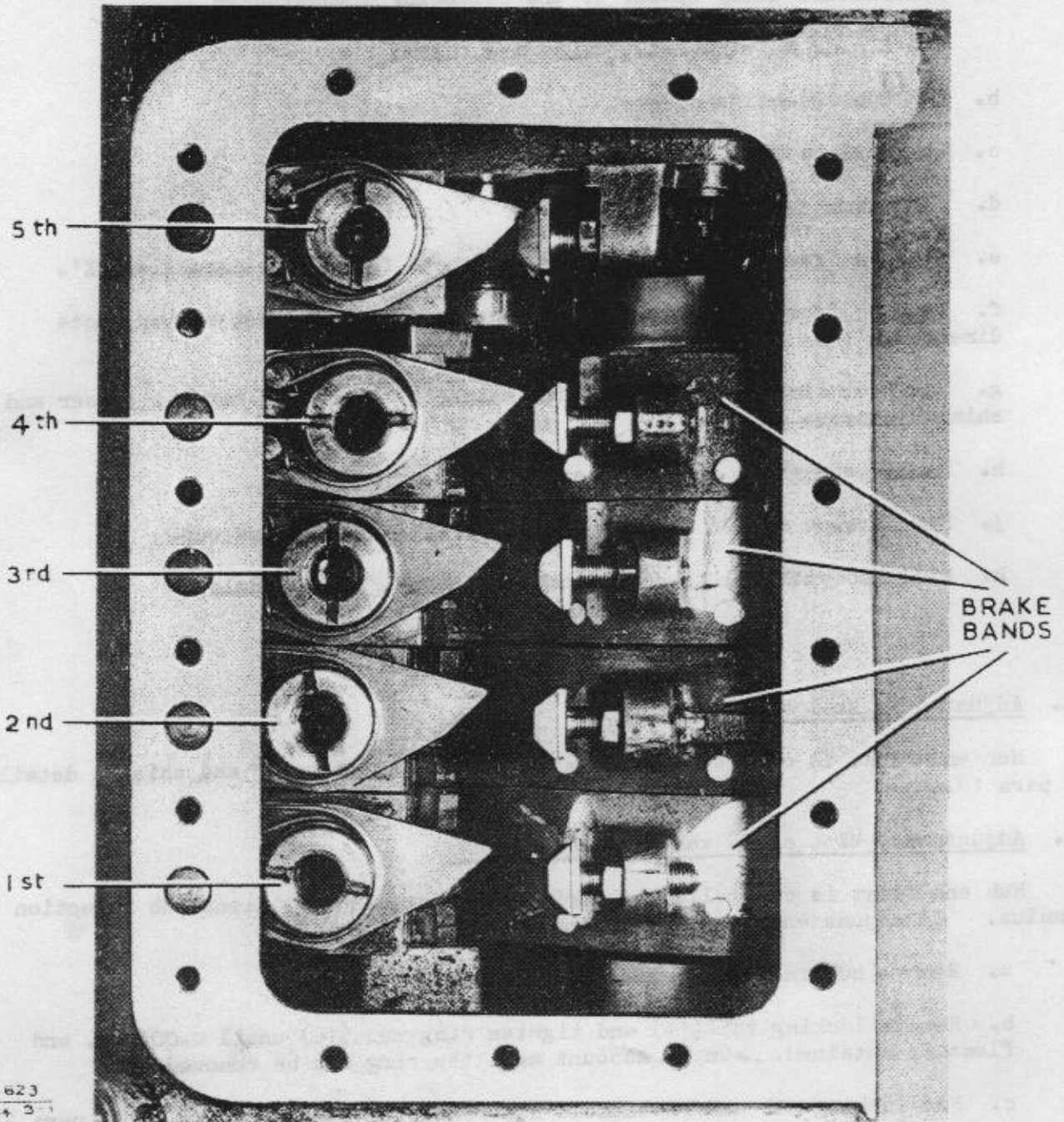


Fig 1 - View of gearbox with top cover removed

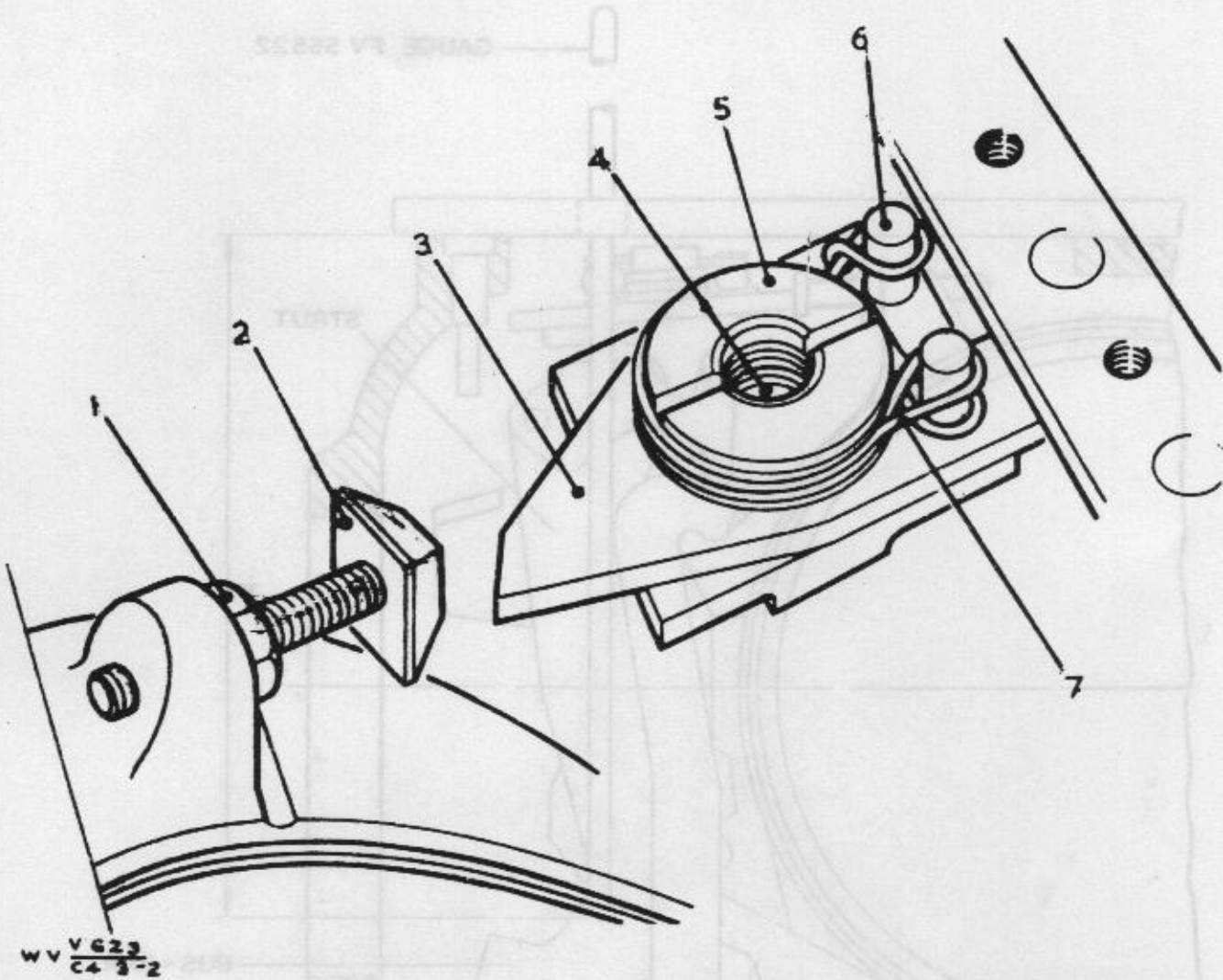
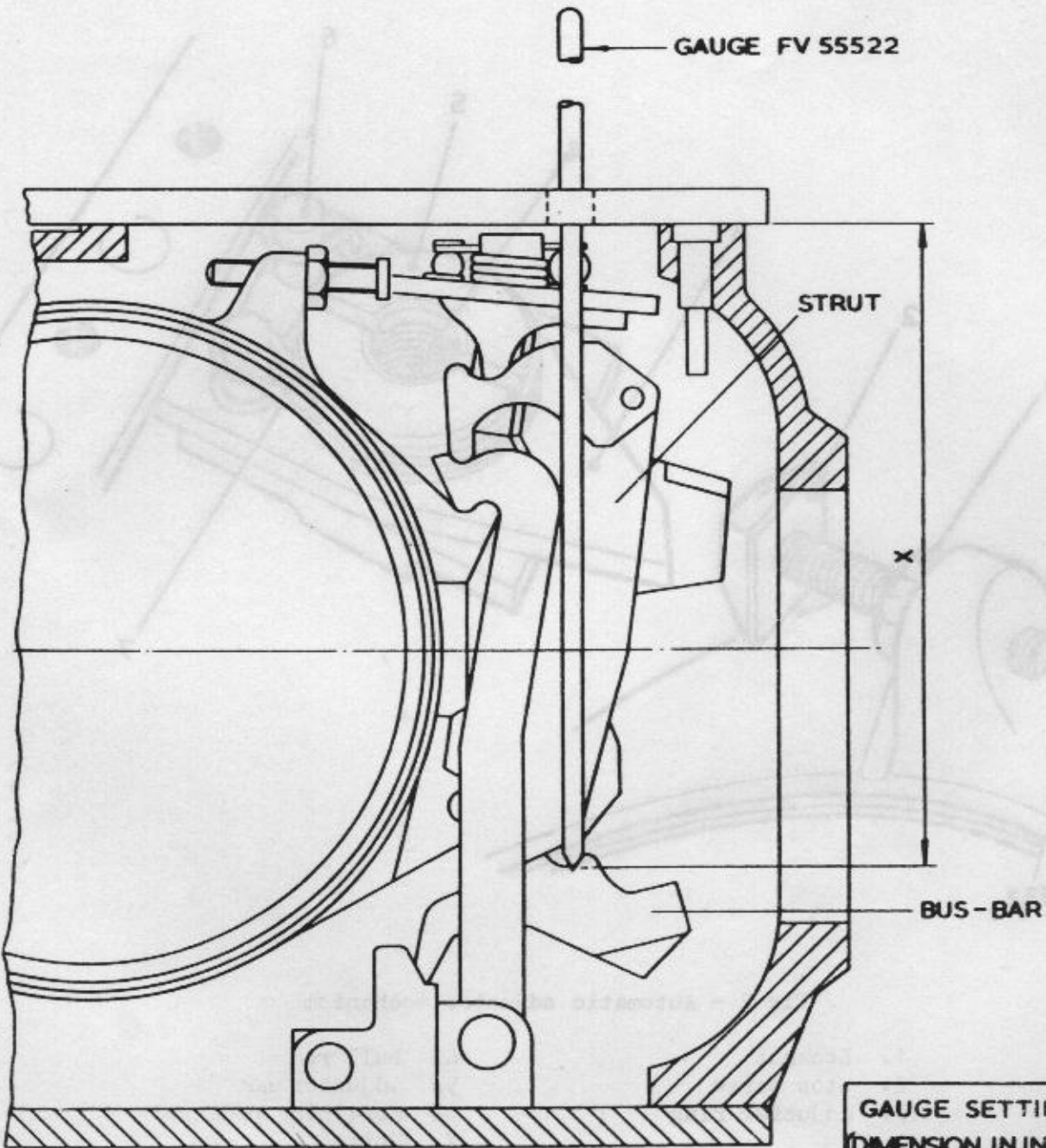


Fig 2 - Automatic adjuster mechanism

- | | |
|------------------|-----------------------|
| 1. Locknut | 4. Pull rod |
| 2. Stop screw | 5. Adjuster nut |
| 3. Adjuster ring | 6. Retaining pedestal |
| | 7. Spring |

GEAR DIMENSION	GEAR DIMENSION
0.50	1.00
1.00	2.00
1.50	3.00
2.00	4.00
2.50	5.00
3.00	6.00



GAUGE SETTING (DIMENSION IN INCHES)	
GEAR	DIMENSION 'X'
1 ST	6.90
2 ND	7.05
3 RD	7.15
4 TH	7.20
TOP	7.45

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Fig 3 - Gauge setting table and section of gearbox showing gauge in position

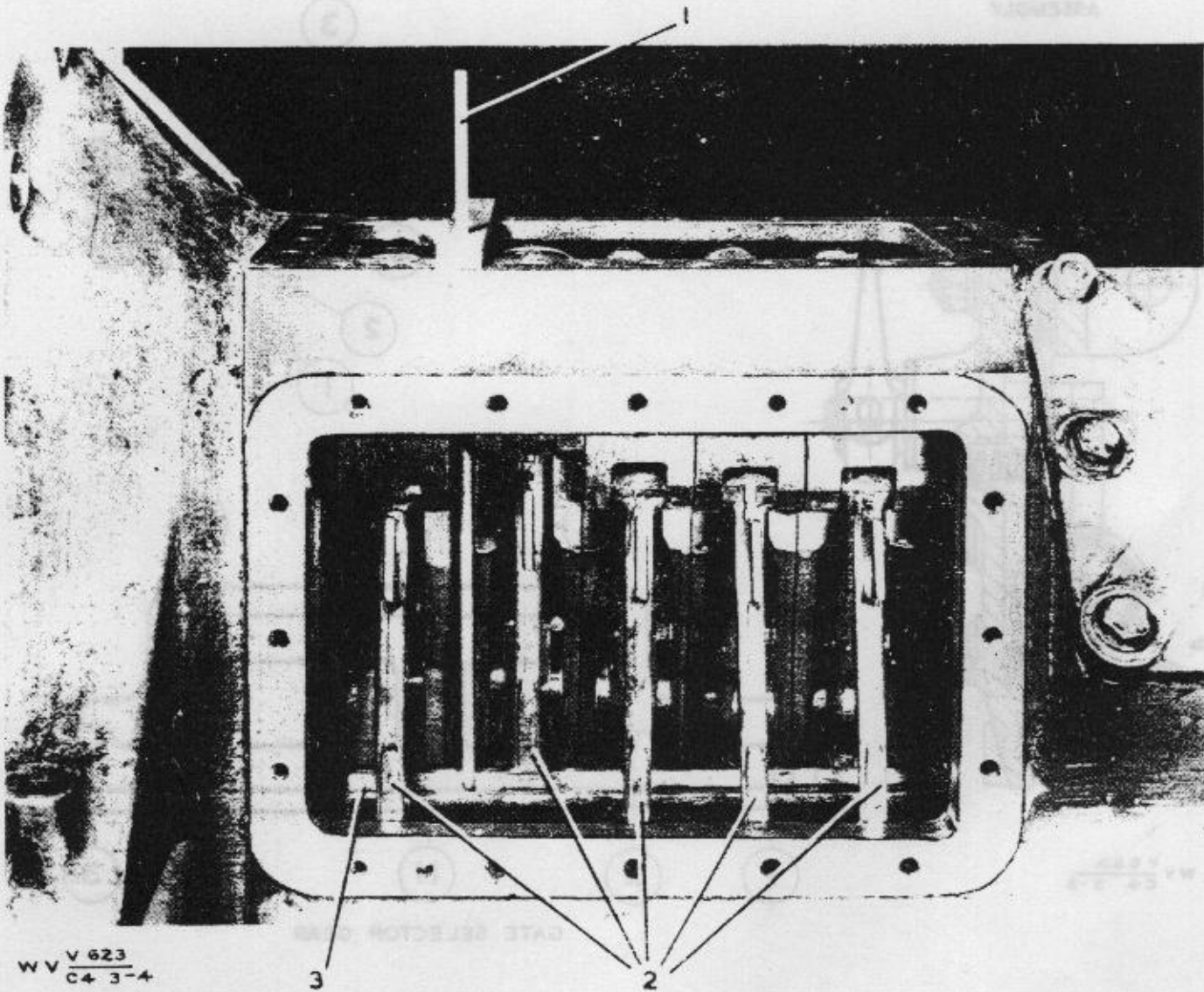
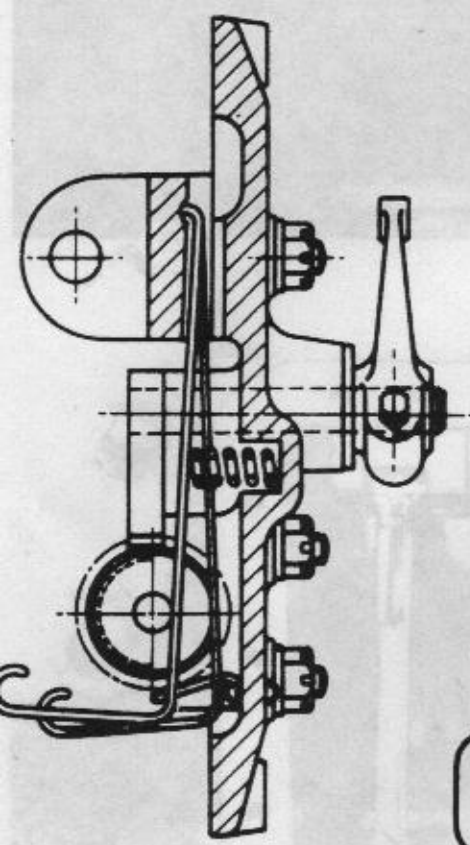


Fig 4 - Side view of gearbox with gear selector cover removed, showing gauge in position and 4th gear engaged

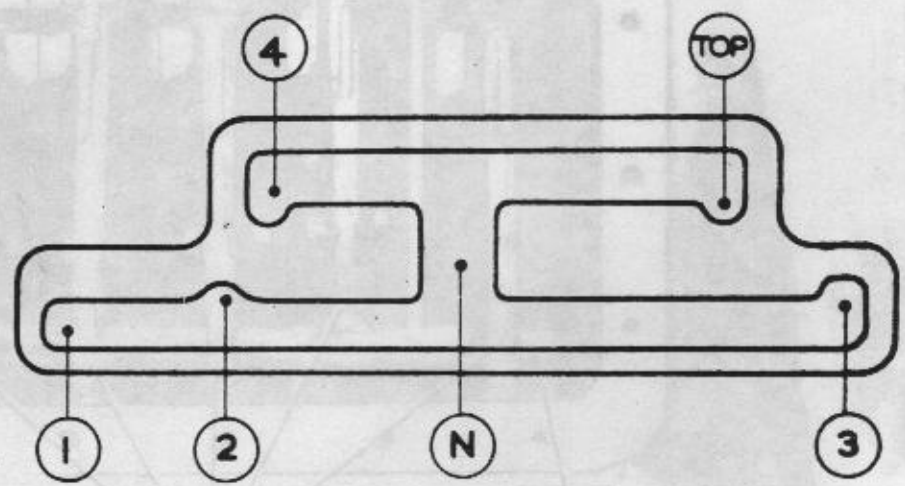
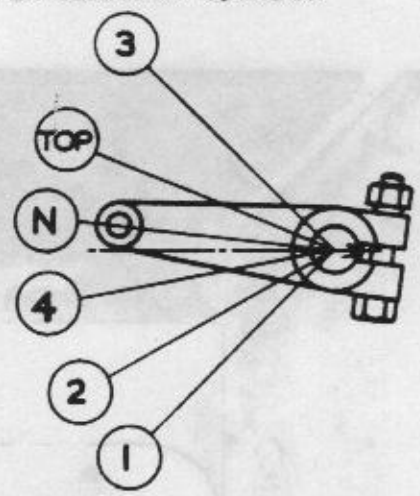
1. Gauge LV9/ASC FV 55522
2. Struts
3. Bus bar

GEAR SELECTOR CAMSHAFT
ASSEMBLY



WV 623
C4 3-5

LEVER SELECTOR GEARBOX



GATE SELECTOR GEAR

Fig 5 - Gearbox control mechanism