

PTO CLUTCH CONTROL SYSTEM ADJUSTMENT

See Section 31 "PTO" for details on PTO clutch servo control adjustment, and for the PTO engage switch adjustment.

SECTION 21 - TRANSMISSIONS**Chapter 1 - Mechanical Transmission (16 x 16) Synchro-Command****CONTENTS**

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SHUTTLE UNIT MAIN DATA

Type	mechanical type with spur gearing, located between the main clutch and the gearbox.
Operating system	hand lever located on left-hand side of operator

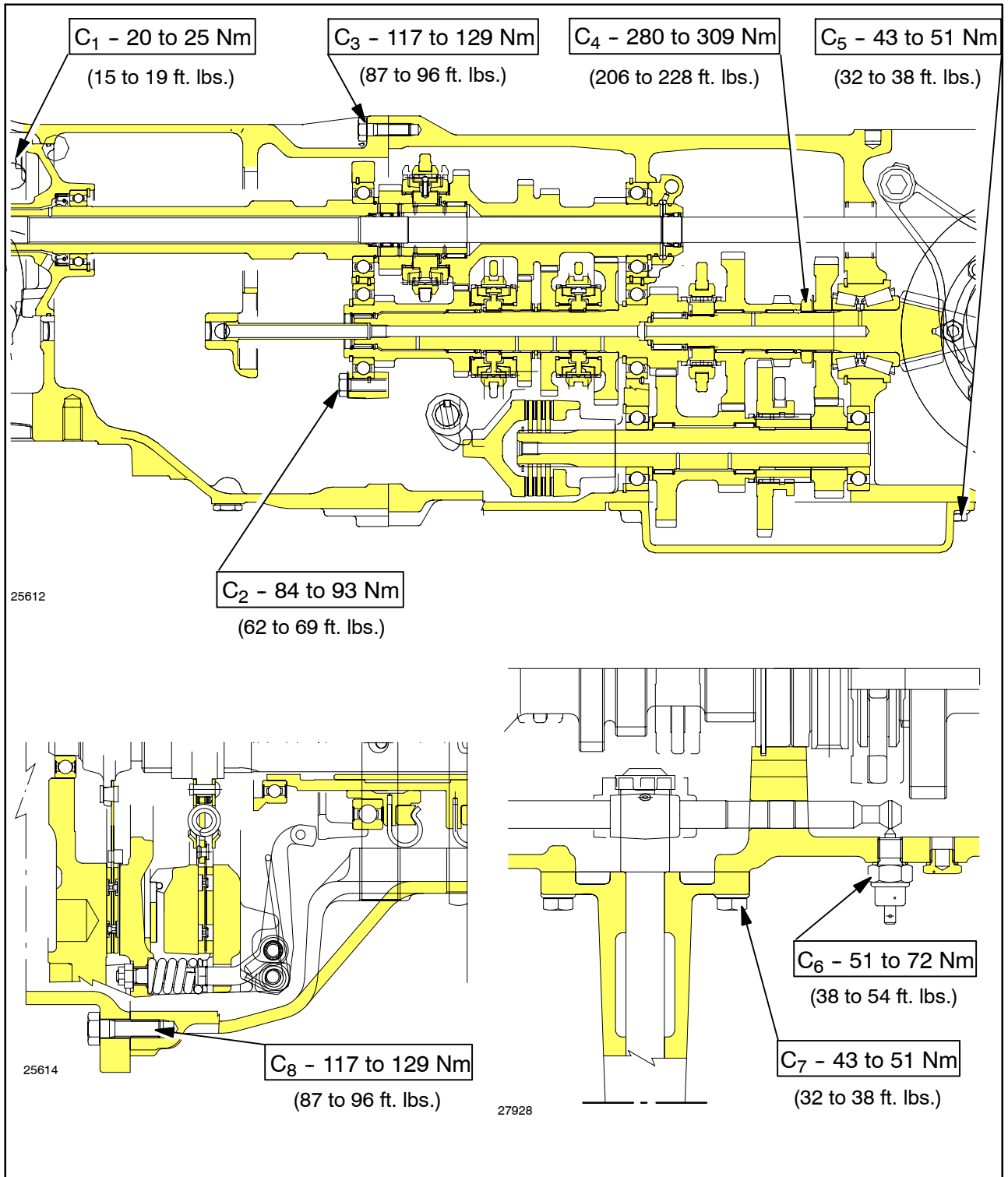
GEARBOX AND RANGE GEAR MAIN DATA

Gearbox (Synchro-Command)	4-speed constant mesh, synchronized on all gears with synchronized F/R shuttle shift.
Gearing type	helical
Range gear (16 x 16)	ordinary gear train with 4 ranges for a total of 16 speeds.
Thickness of gearbox driving shaft adjustment shim (4, page 8)	mm 0.5 - 0.75 - 1.0 - 1.25 - 1.5 - 1.75 - 2.0 - 2.25 (in.) (0.19 - 0.29 - 0.39 - 0.49 - 0.59 - 0.68 - 0.78 - 0.88)
Thickness of gearbox driven shaft adjustment shim (12, page 8)	mm 0.5 - 0.75 - 1.0 - 1.25 - 1.5 - 1.75 - 2.0 - 2.25 (in.) (0.19 - 0.29 - 0.39 - 0.49 - 0.59 - 0.68 - 0.78 - 0.88)
Springs for detent balls on gearbox and range gear control rods:	
- spring free length	mm 42 (in.) (1.65)
- length of springs under load of 75.5 to 83.3 N (16.97 to 18.72 ft. lbs.)	mm 35 (in.) (1.37)
Springs (1, page 10) for gearbox and range gear control levers:	
- spring free length	mm 44 (in.) (1.73)
- length of springs under load of 31.4 to 35.3 N (7.05 to 7.943 ft. lbs.)	mm 35 (in.) (1.37)

TORQUE SETTINGS

PART (Refer to Figure 1)	Thread	Tightening torque	
		Nm	ft. lbs.
Sleeve cover retaining nuts (C ₁)	M 8 x 1.25	20 to 25	15 to 19
Gearbox driving and driven shafts bearing cover screws (C ₂) ...	M 10 x 1.25	84 to 93	62 to 69
Retaining bolts securing creeper clutch casing to rear transmission/gearbox casing (C ₃)	M 12 x 1.25	117 to 129	87 to 96
Driven gear shaft locknut (C ₄)	M 32 x 1.5	280 to 309	207 to 228
Drive gear housing cover retaining screws (C ₅)	-	43 to 51	32 to 38
Pressure switches (C ₆)	-	51 to 72	38 to 54
Parking brake inspection cover, gearbox and range control relay levers support cover retaining screws (C ₇)	M 10 x 1.25	43 to 51	32 to 38
Bolts or nuts securing creeper clutch casing to the engine (C ₈) ..	M 12 x 1.25	117 to 129	87 to 96

TORQUE SETTINGS



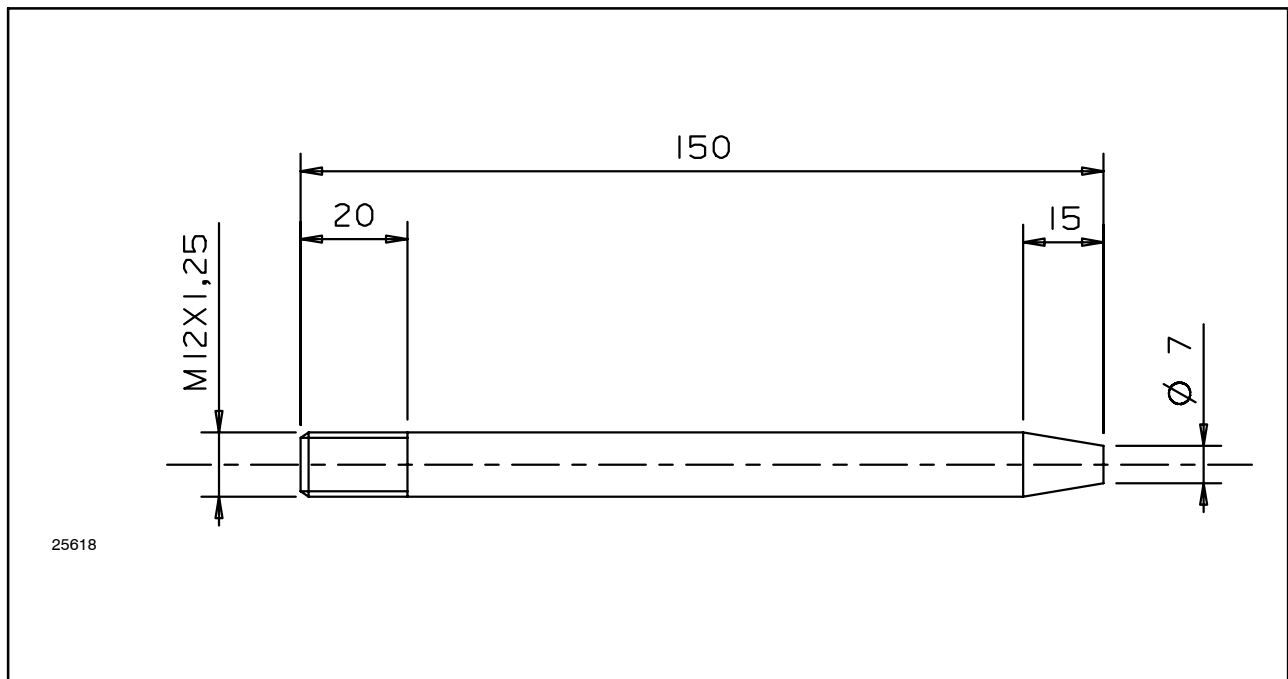
TOOLS

Warning - The operations described in this section can only be carried out with **ESSENTIAL** tools indicated by an **(X)**.

To work safely and efficiently and obtain the best results, it is also necessary to use the recommended specific tools listed below and certain other tools, which are to be made according to the drawings included in this manual.

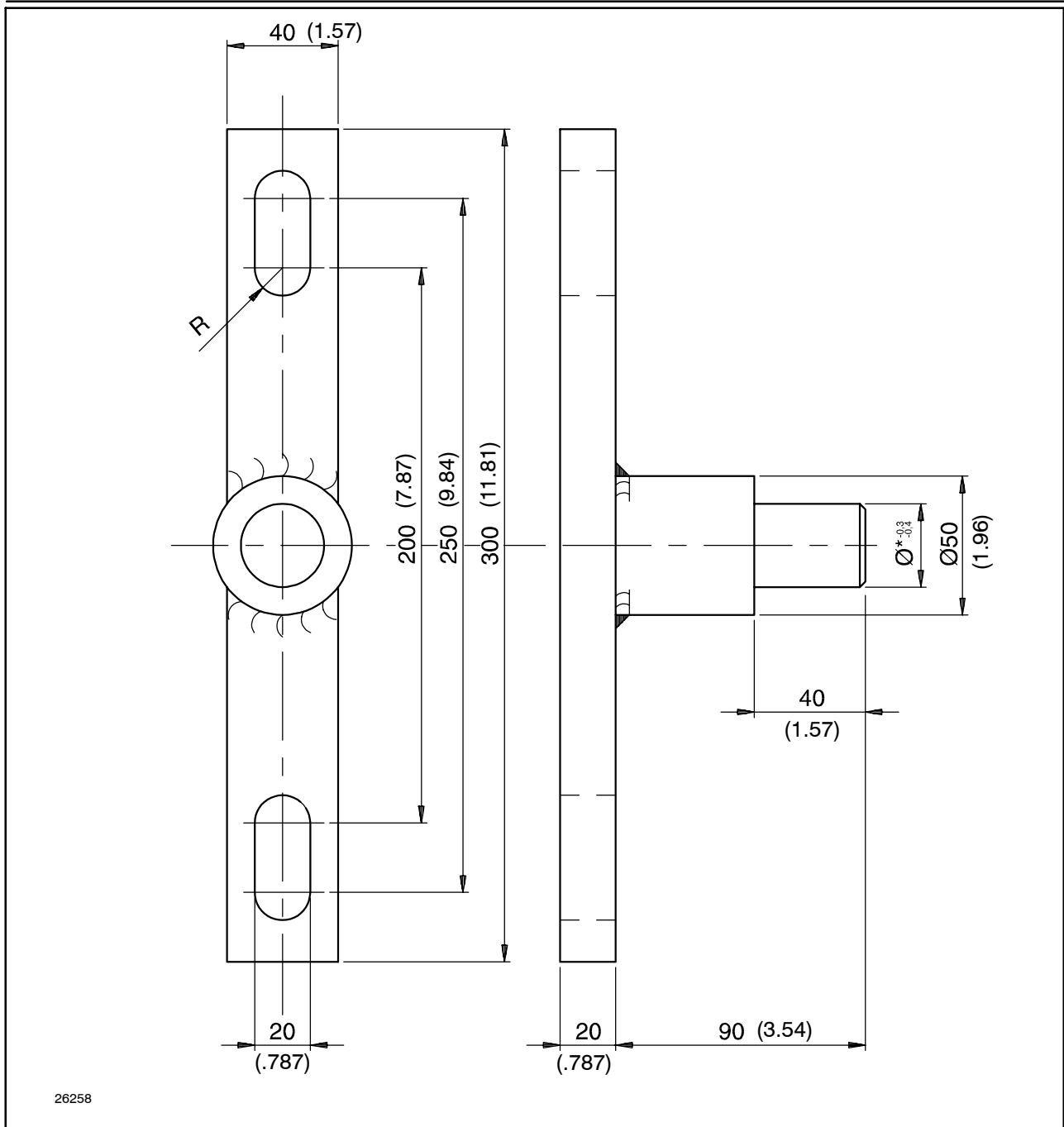
List of specific tools required for the various operations described in this Section.

380000227	Clutch casing lift hook.	X 380001617	Pliers for gearbox shafts circlips.
380000301	Rotating stand for overhaul operations.	380001618	Driving shaft installation guide.
X 380001614	Tool for gearbox driving and driven shafts adjustment.	380001619	Driven shaft installation guide.
380001615	Driving shaft rod for lifting unit.	380001610	Adjuster handle (with 380001620 and 380001609).
380001616	Driven shaft retaining tool.	380001620	Power take-off drive shaft seal splining tool (with 380001610).
		380001609	Power take-off drive shaft roller bearings splining tool (with 380001610).
		50091	Tool for removal-installation final drives (see Section 27).
		380006006	Electronic Service Tool (use the Calibration and Diagnostic Unit as a substitute).
		380006007	Electronic Service Tool less lap top.
		380000282	Calibration and Diagnostic Unit (use the Electronic Service Tool as a substitute).



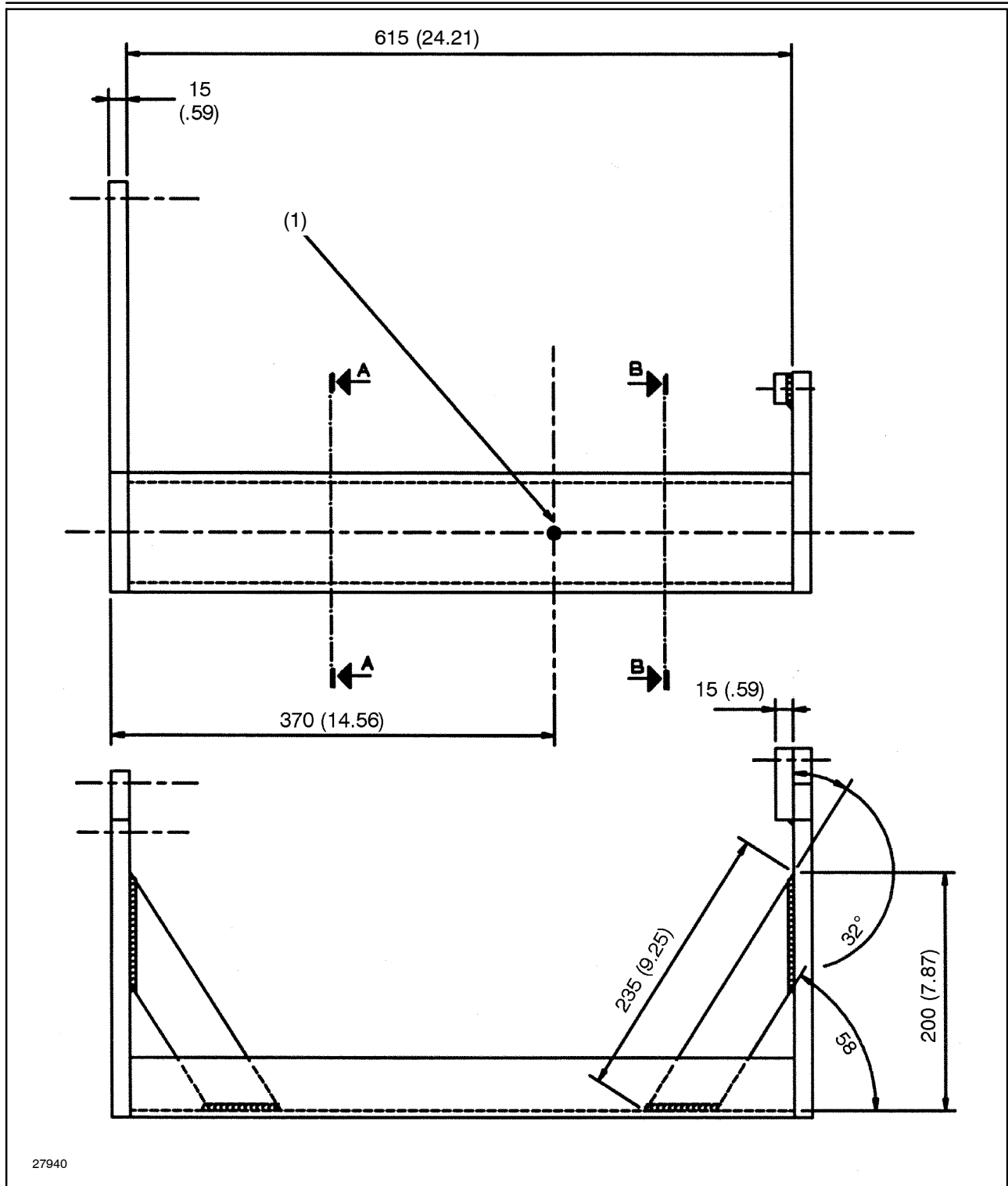
Guide pin for re-fitting the gearbox in the casing (Mark part with no. 50158 - Measurements in mm)

Make in C 40 material.



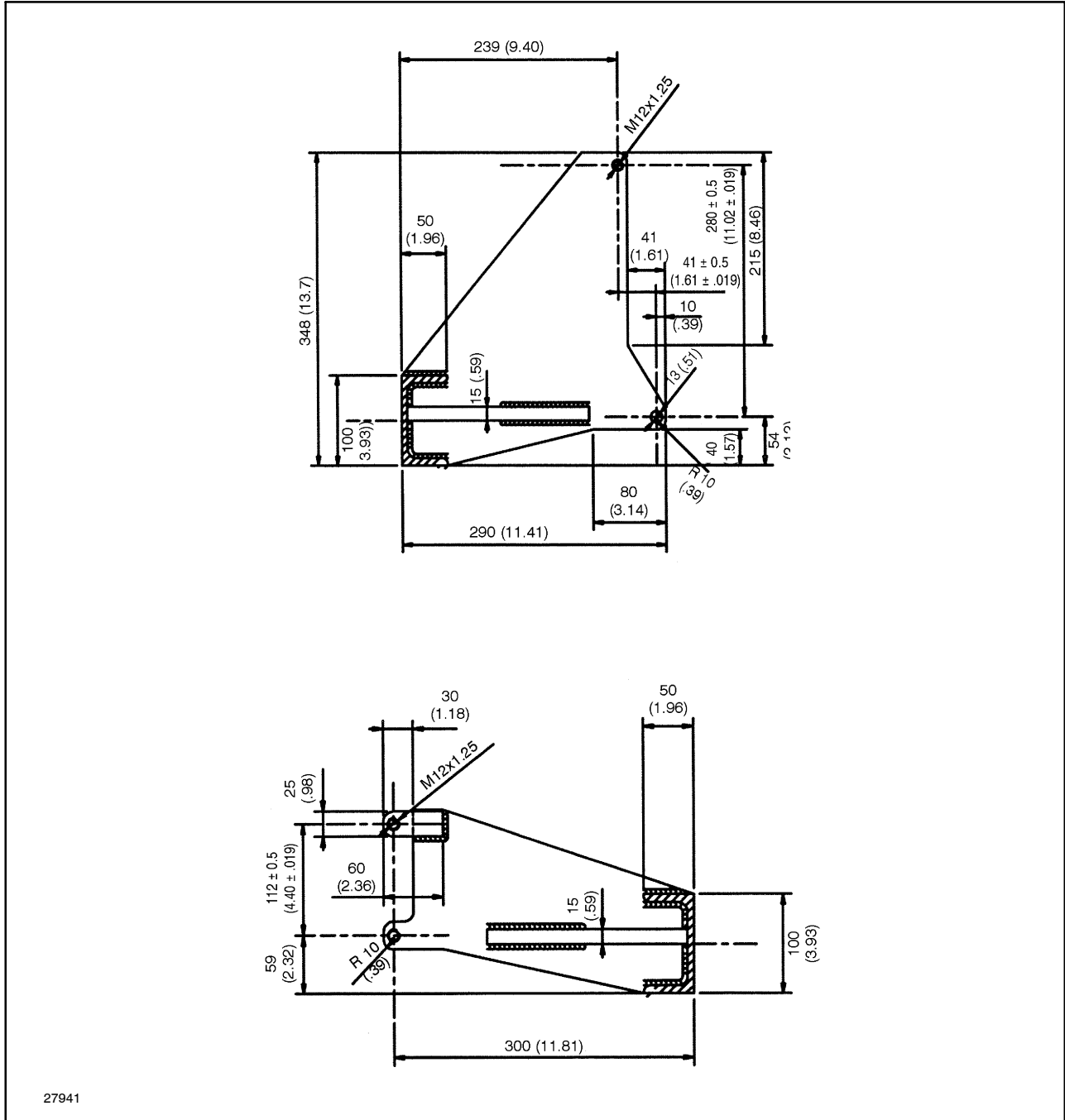
**Tool to be made for lateral gear removal-installation, use with a part of 50091.
(Mark tool No. 50114 - Measurement in mm [ins.]**

Make in Fe 42 C material - (*) Measurement according to hoist seat.



**Bracket to be made for gearbox overhaul on rotating stand
(Mark tool No. 50157 - Measurement in mm [ins.]**

1. Rotating stand axis.
Make in Fe 42C material.

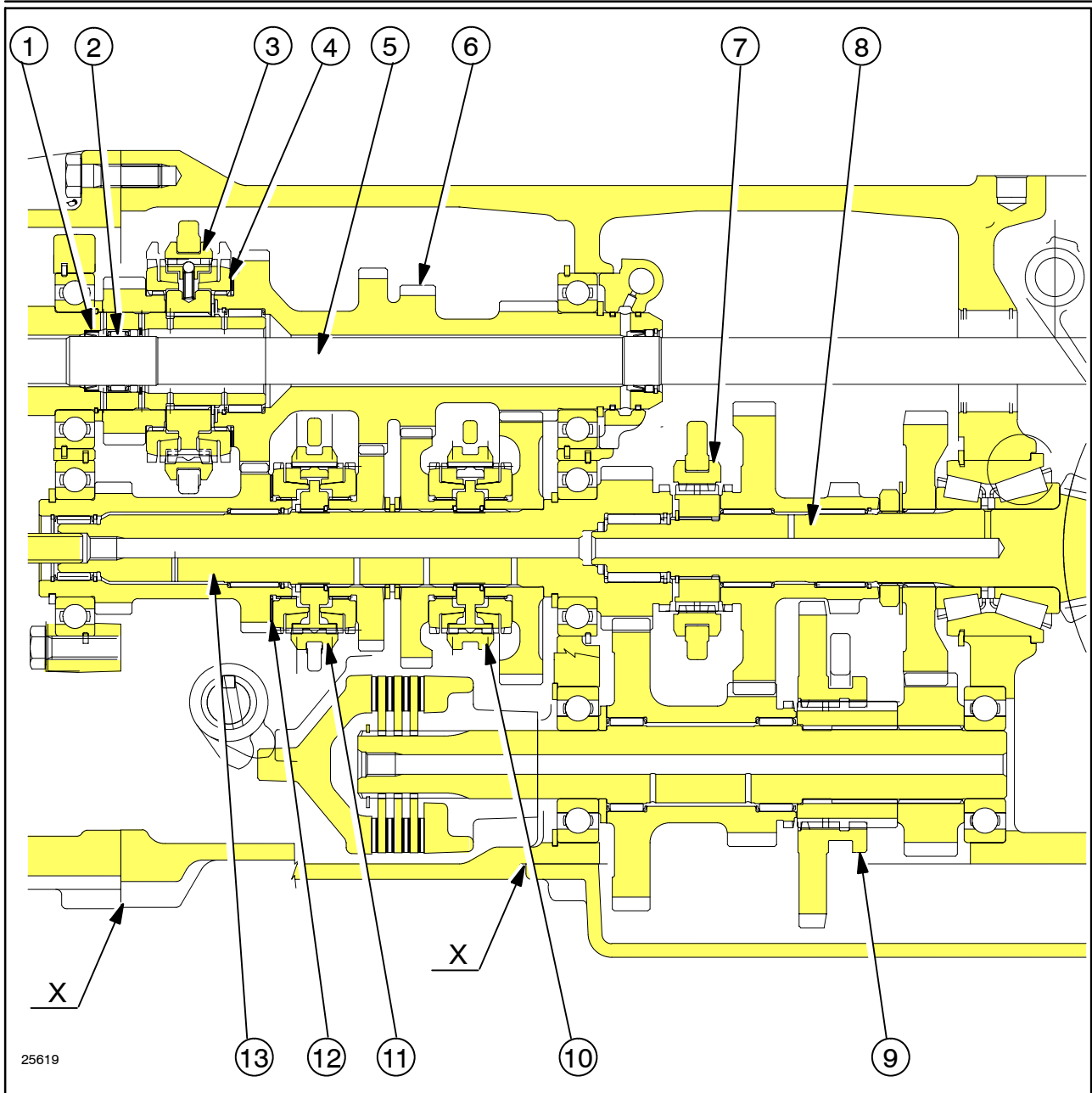


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**Bracket to be made for gearbox overhaul on rotating stand
(Mark tool No. 50160 - Measurement in mm [ins.])**

Make in Fe 42C material.



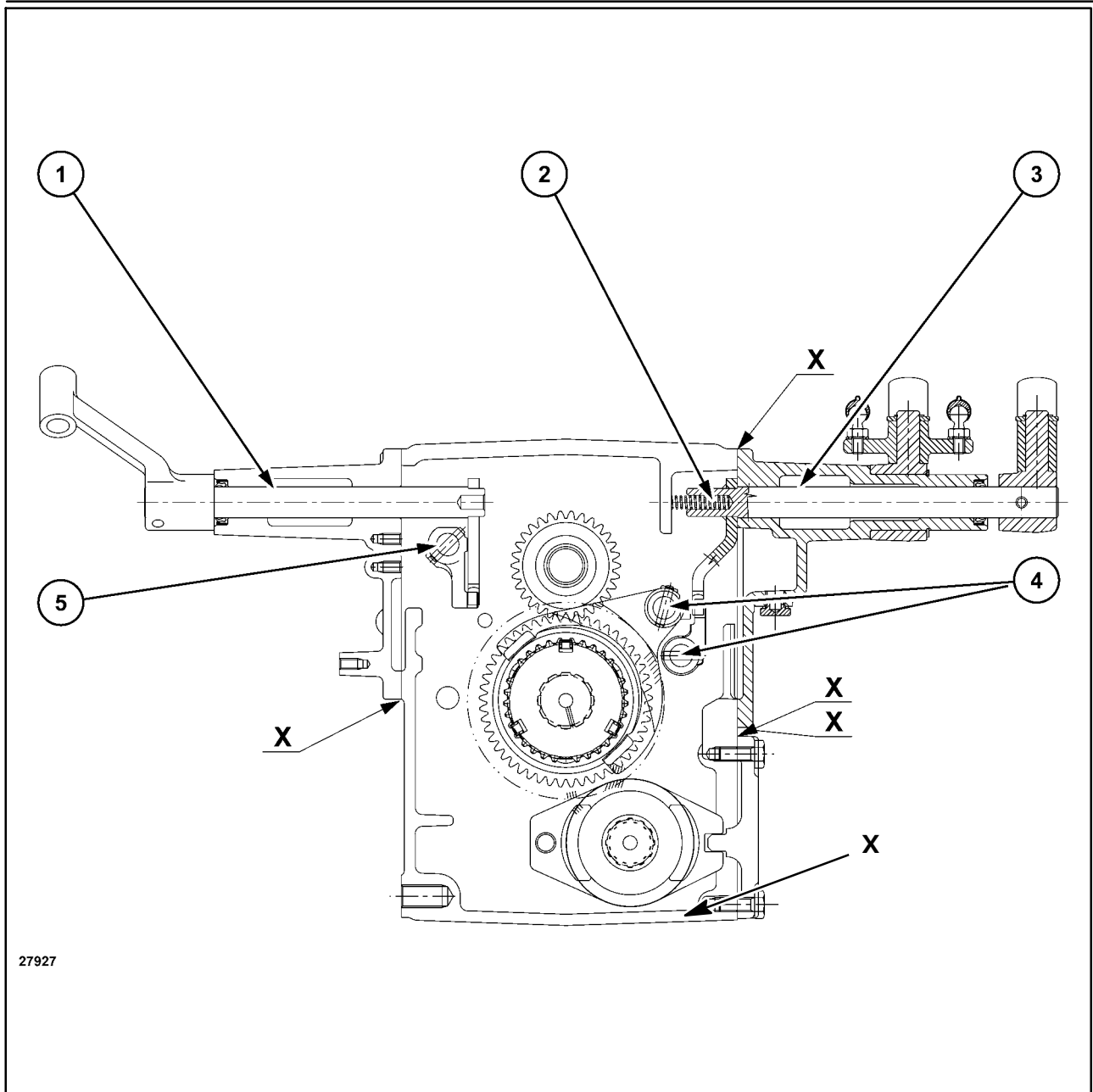
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Longitudinal cross-sectional view of gearbox and gear range (16 + 16 Synchro-Command)

- | | |
|---|---|
| 1. Seal. | 8. Bevel pinion shaft. |
| 2. Power take-off shaft support roller bearings. | 9. Selector sleeve for low or medium-high speeds. |
| 3. Shuttle control synchronizer. | 10. Synchronizer for 1st and 2nd speed. |
| 4. Gearbox driving gear clearance adjusting shim. | 11. Synchronizer for 3rd and 4th speed. |
| 5. Power take-off shaft. | 12. Gearbox driven shaft gear clearance adjusting shim. |
| 6. Gearbox driving gear. | 13. Gearbox driven shaft. |
| 7. Selector sleeve for high or medium-low speeds. | |

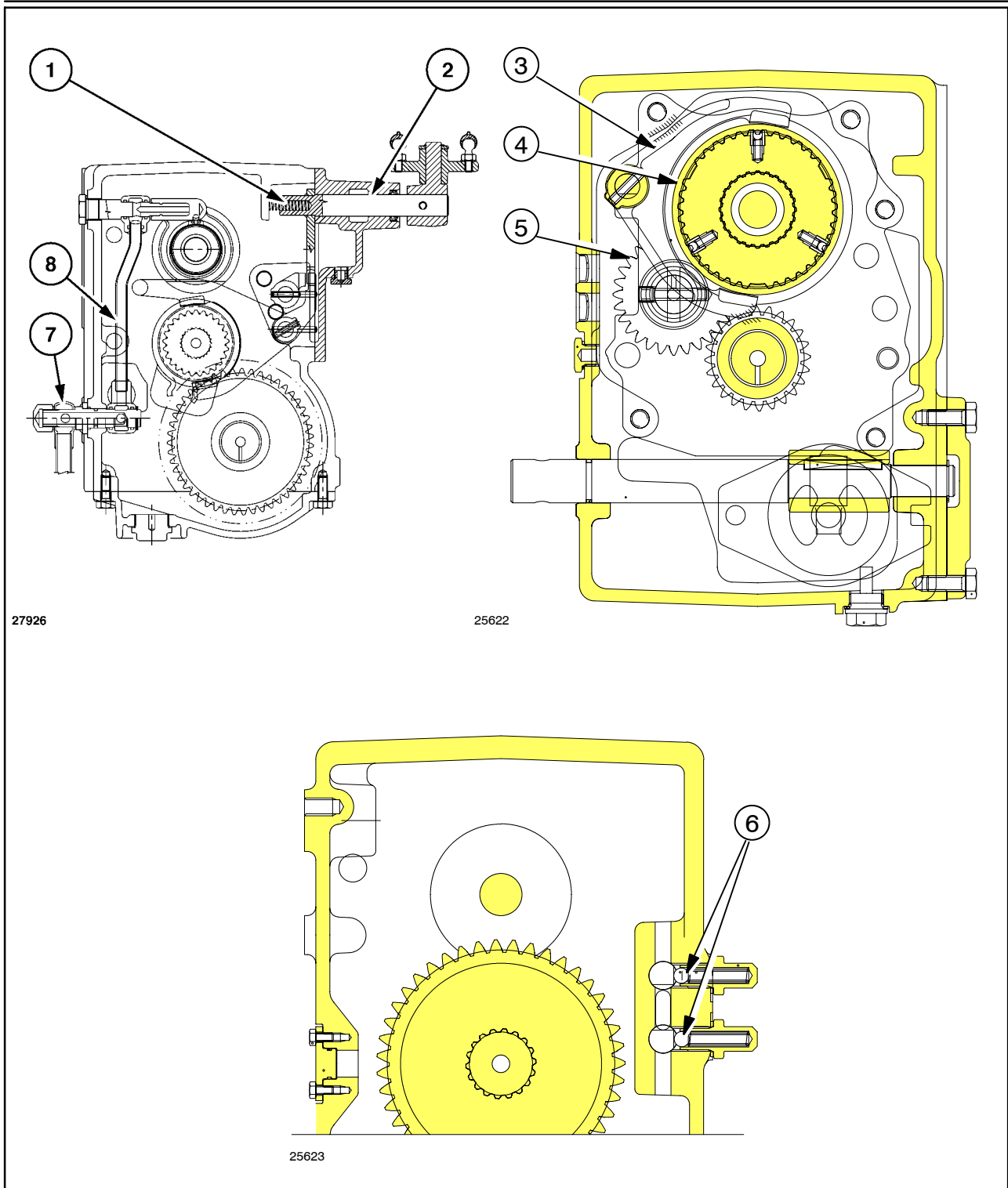
NOTE: On assembly apply sealing compound to surfaces X as shown on page 34.



Cross-sectional view of gearbox and range gear

- | | |
|--------------------------------------|-----------------------------------|
| 1. Shuttle control external rod. | 4. Gear selector internal rod. |
| 2. Gear control external rod spring. | 5. Shuttle selector internal rod. |
| 3. Gear control external rod. | |

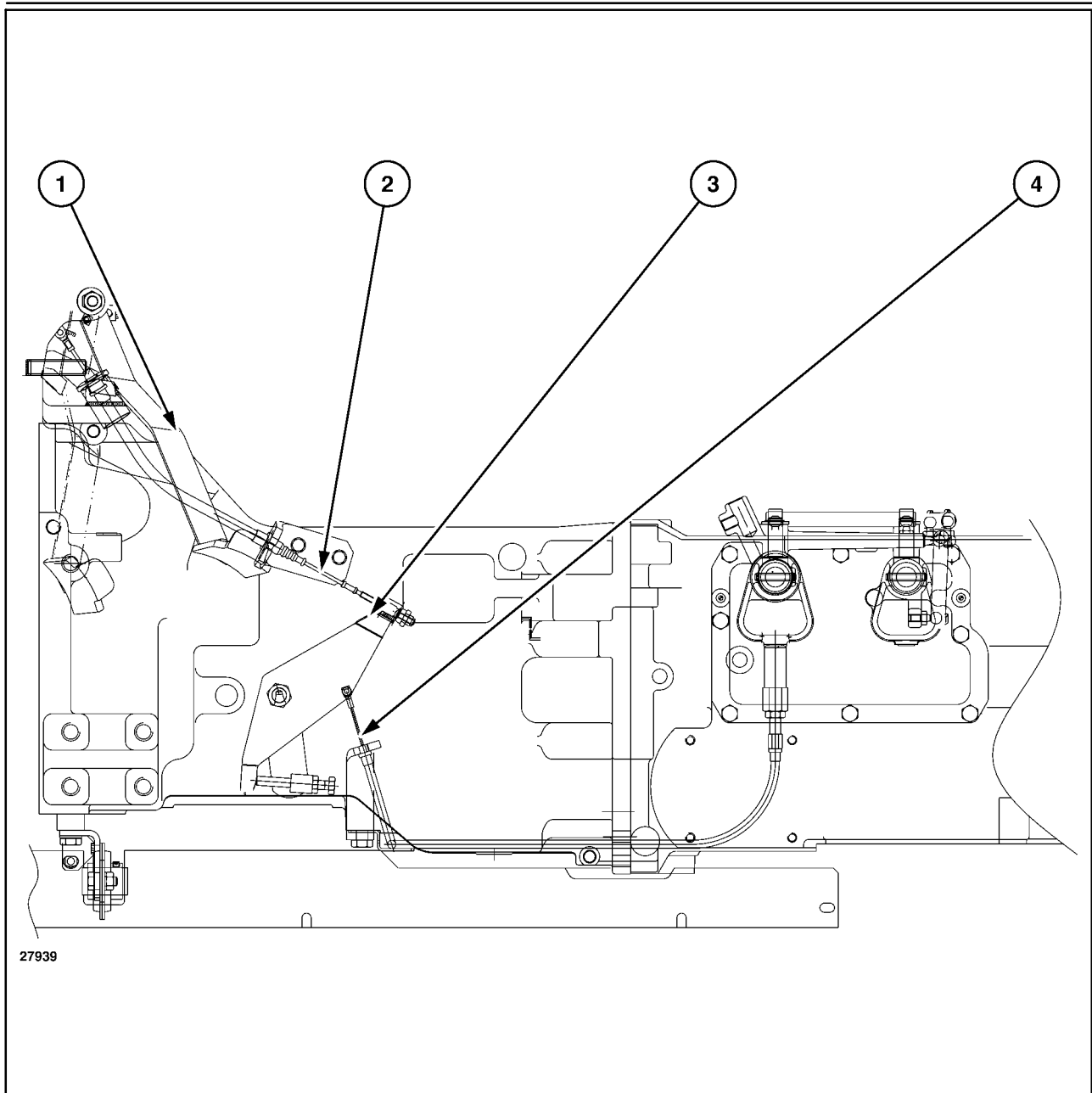
NOTE: On assembly apply sealant to surfaces **X** as shown on page 34.



Cross-sectional view of gearbox and range gear

- | | |
|--|--------------------------------------|
| 1. Range gear control external rod spring. | 5. Shuttle relay gear (reverse gear) |
| 2. Range gear control external rod. | 6. Detent ball and spring. |
| 3. Shuttle control fork. | 7. Lubricating oil external pipes. |
| 4. Shuttle selector synchronizer. | 8. Lubricating oil internal pipes. |

NOTE: On assembly apply sealant to surfaces X as shown on page 34.



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View of safety pin control

- | | |
|----------------------------------|---|
| 1. Gearbox clutch control pedal. | 3. Gearbox clutch control external lever. |
| 2. Gearbox clutch control cable. | 4. Safety pin control cable. |

DESCRIPTION AND OPERATION

Gearbox and Shuttle (Synchro-Command)

4-speed gearbox with constant-mesh helical gears controlled by two synchronizers.

The range gear has cascade-type constant-mesh spur gears.

The range gear provides 4 gears (16 x 16 version).

The gearbox and the range gears are controlled by two independent levers located on the right-hand side of the operator.

The shuttle is a mechanical device making it possible to obtain 16 forward gears and 16 reverse gears. It is controlled by a lever located on the cab platform to the left of the operator.

The shuttle is composed of a group of three spur gears: reverser driving gear, reverser driven gear and intermediate gear, engagement is by means of a synchronizer located in the gear unit.

The shuttle is installed inside the clutch casing, between the clutch and the gearbox.

Lubrication is by means of the oil in the rear transmission/gearbox.

GEARBOX, GEAR RANGE AND SHUTTLE TROUBLESHOOTING

Problems	Possible causes	Remedies
Spontaneous disengagement of gearbox.	<ol style="list-style-type: none"> 1. Levers and relay rods incorrectly adjusted. 2. Control levers retaining springs damaged. 3. Synchronizer teeth or selection sleeves damaged. 4. Engagement stroke incomplete. 	<p>Adjust correctly.</p> <p>Replace springs.</p> <p>Remove the transmission-gearbox casing and replace the synchronizers or the sleeves.</p> <p>Eliminate the cause and reset the complete stroke.</p>

(continued overleaf)

GEARBOX, GEAR RANGE AND SHUTTLE TROUBLESHOOTING

(continued)

Problems	Possible causes	Remedies
Difficulty in engaging the gearbox.	<ol style="list-style-type: none"> 1. External levers and relay rods incorrectly adjusted. 2. Stiffness and/or partial seizure of external levers and relay rods. 3. Main clutch drag. 4. Synchronizers or selection sleeves damaged. 5. Internal control elements do not slide freely: rods, forks and sleeves. 	<p>Adjust correctly.</p> <p>Check rod pivots and lubricate.</p> <p>See Section 18.</p> <p>Remove the transmission-gearbox casing and replace the synchronizers or the sleeves.</p> <p>Overhaul the controls.</p>
Excessive noise in gearbox or shuttle.	<ol style="list-style-type: none"> 1. Internal components worn or defective. 	<p>Remove the transmission-gearbox casing and replace the damaged parts.</p>

Op. 21 118 10 - 21 118 12
REAR TRANSMISSION-GEARBOX CASING
Removal-Installation

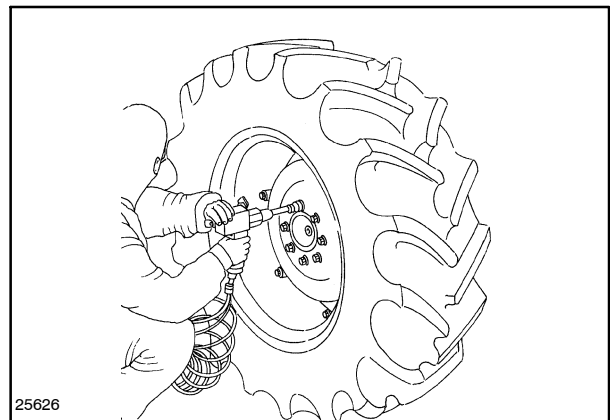
⚠ WARNING ⚠

Lift and handle all heavy parts using suitable lifting equipment

Make sure that the units or parts are supported by means of suitable slings and hooks. Make sure that no-one is standing in the vicinity of the load to be lifted.

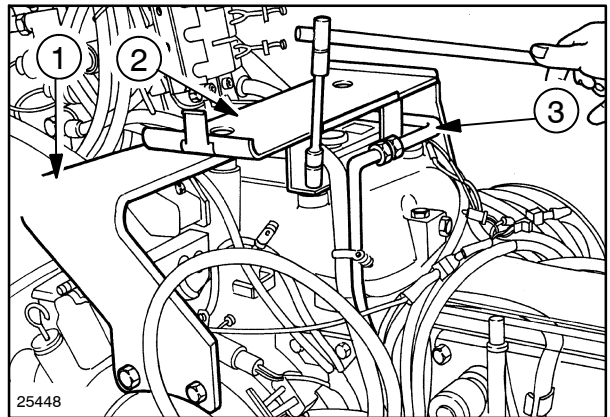
In order to remove the rear transmission-gearbox the cab must be removed, following the instructions noted in Section 90, Chapter 1. Proceed as follows.

1. Position support stands under the rear transmission and remove the rear wheels.
2. Remove the HPL top link.



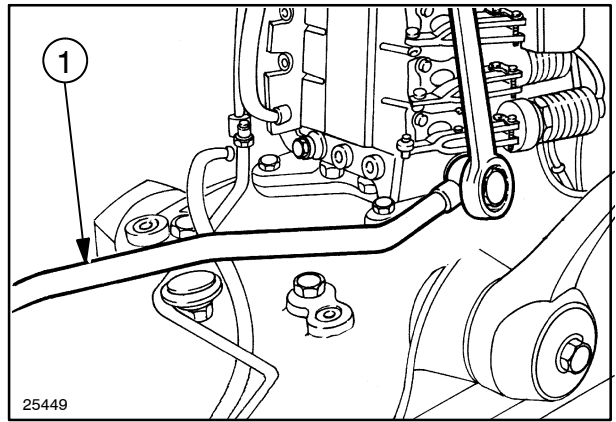
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3. Remove the battery, unscrew the retaining bolts and remove the battery supports (1, 2 and 3).



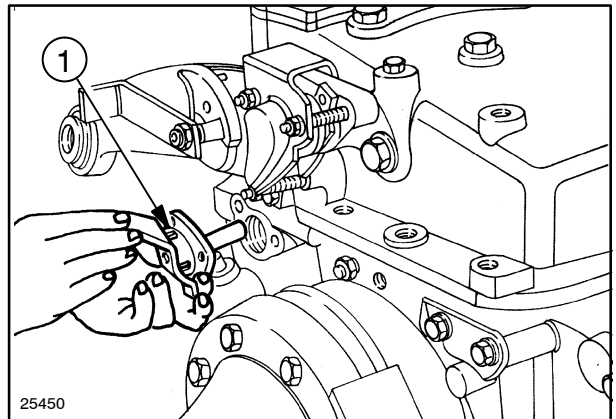
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4. Disconnect and remove the lift auxiliary control valve control pipes (1).



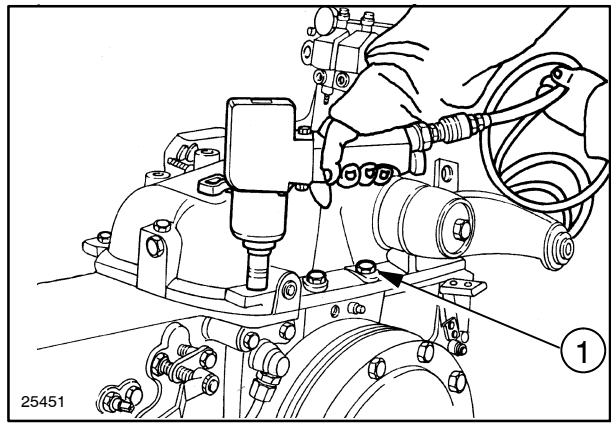
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5. Unscrew the retaining bolts and extract the Lift-O-Matic control lever (1).



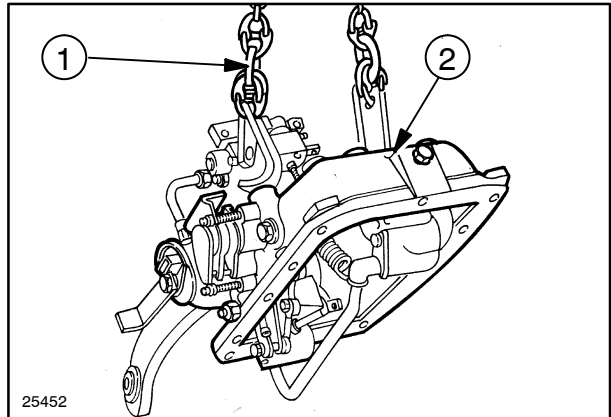
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6. Unscrew the retaining bolts on the lift (1) and recover the trailer brake control pipes support bracket.
Disconnect the power take-off speed sensor connections, if necessary.



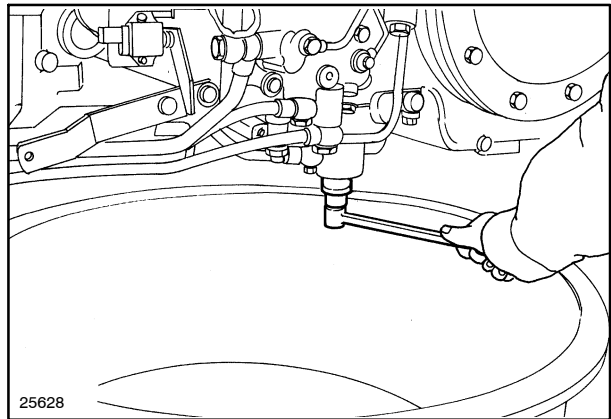
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7. Attach the lifting hook **380000227** (1) to the lift (2) and, by means of the hoist, raise and remove the lift.



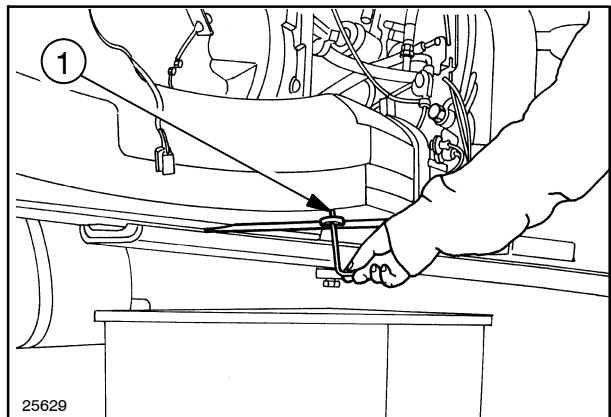
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8. Unscrew the drainage plug on the drive gear housing and recover the oil in a suitably dimensioned container.
9. Disconnect all of the electrical connections, marking them (if necessary) to facilitate re-connection.



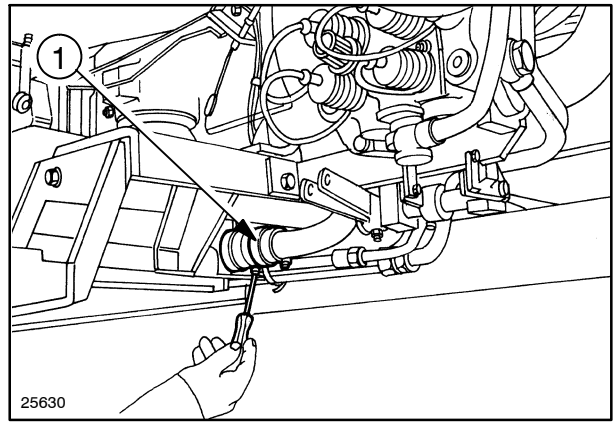
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10. Remove the drainage plug (1) and recover the gas oil in a suitably dimensioned container.



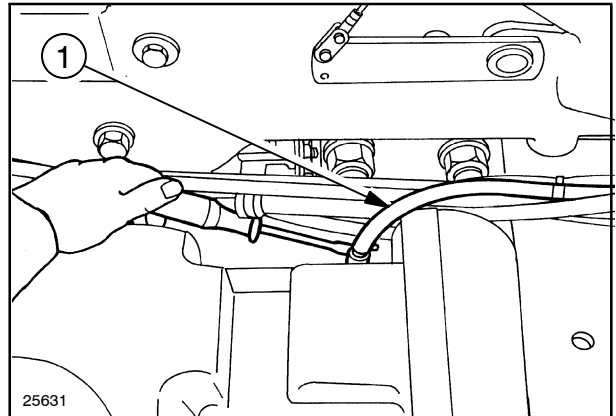
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11. Loosen the clamp and detach the side tank sleeve (1).



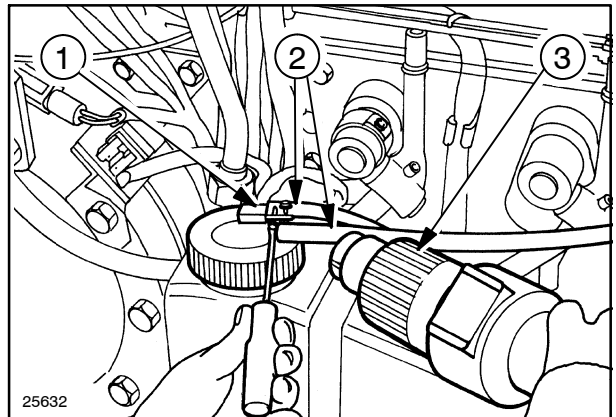
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12. Unscrew the clamp and detach the gas oil intake pipes (1).



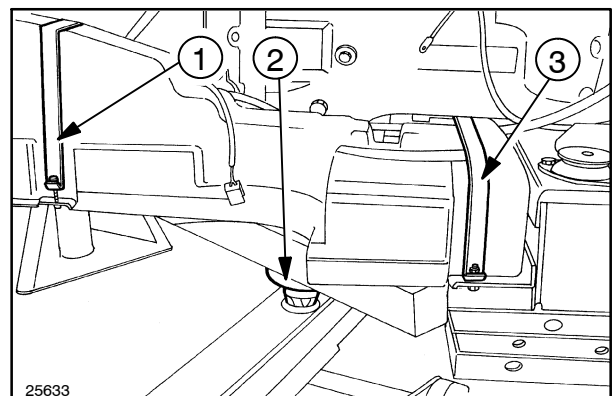
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13. Disconnect the electrical connections (1), loosen the clamps and heat the pipes (2), using a heater (3), in order to facilitate the removal of the relative unions.



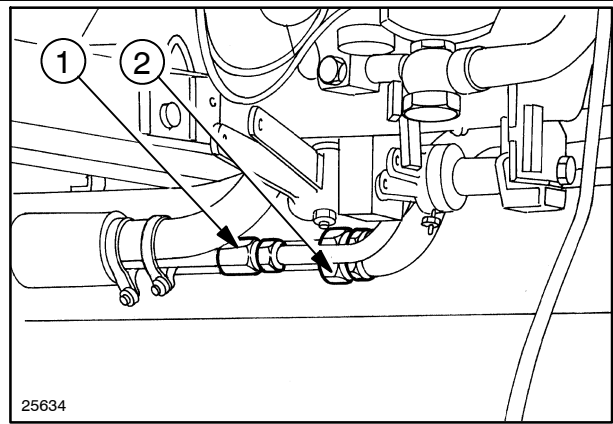
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14. Position a hydraulic jack (2) under the side tank, unscrew the clamp retaining bolts (1 and 3) and remove the tank.



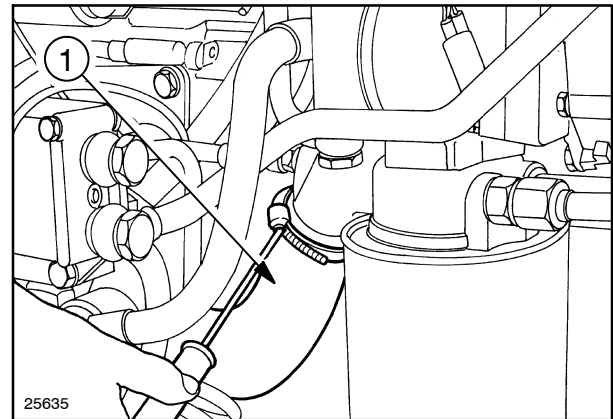
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15. Detach the support bracket pipes (1 and 2) from the cab right-hand support. Unscrew the unions on the pipes (1 and 2) of the trailer brake and lift control.



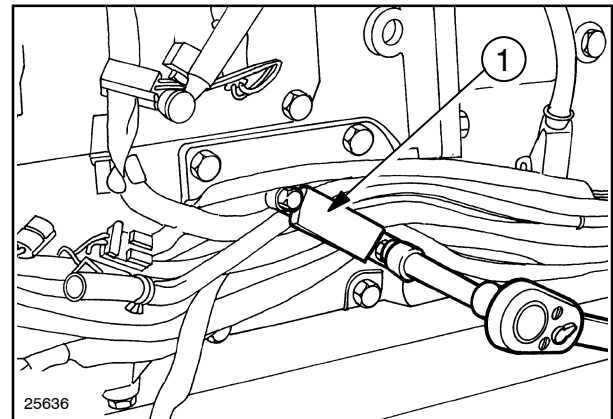
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16. Unscrew the clamp and detach the filter supply pipes (1). Unscrew the bolts that secure the pipes (1) on the rear transmission casing and remove.



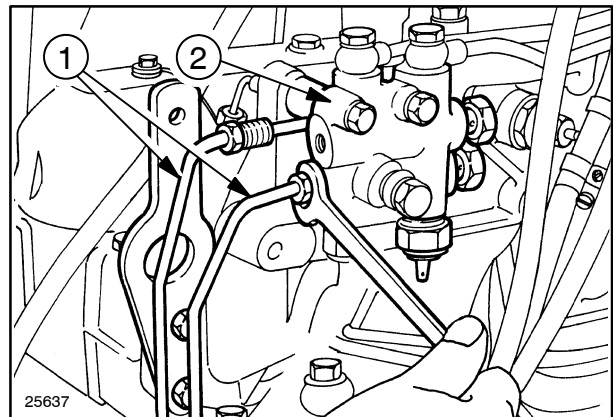
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17. Unscrew the retaining bolts and detach the electrical leads clamp(1), positioning the leads on the engine.



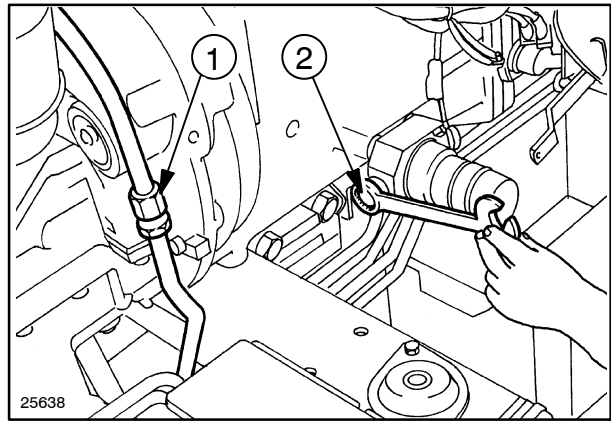
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18. Disconnect the brake control pipes (1) from the brake block (2), the rear transmission casing and remove.



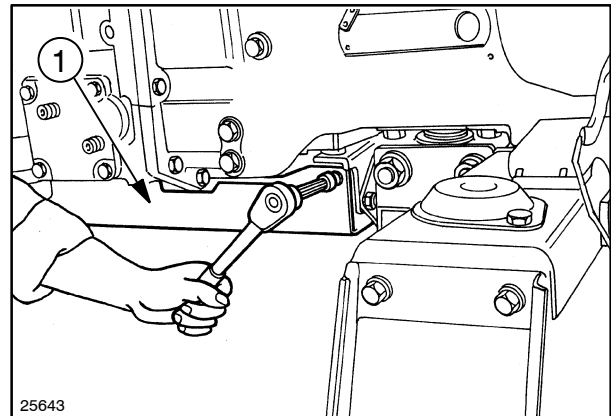
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19. Disconnect the unions (1 and 2) of the services control oil delivery pipes.



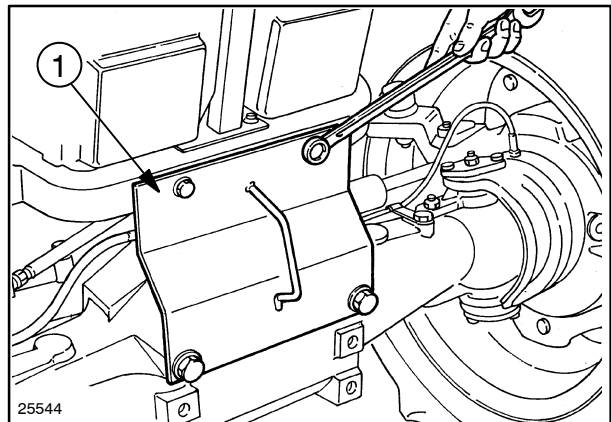
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20. Unscrew the retaining bolts and detach the rear guard (1).



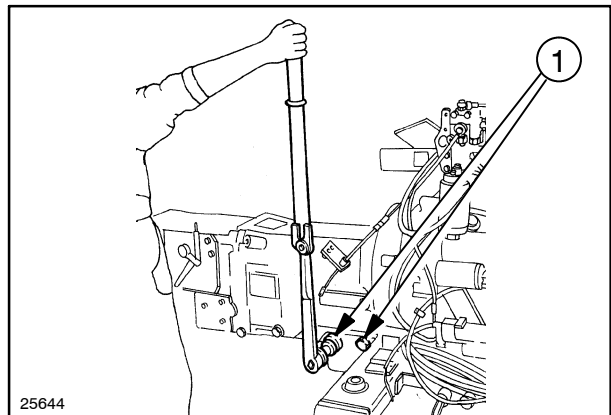
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21. Position the bracket **380001613** (1) and fix to the engine and axle.



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22. Unscrew the two rear nuts (1) that retain the front guard.



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