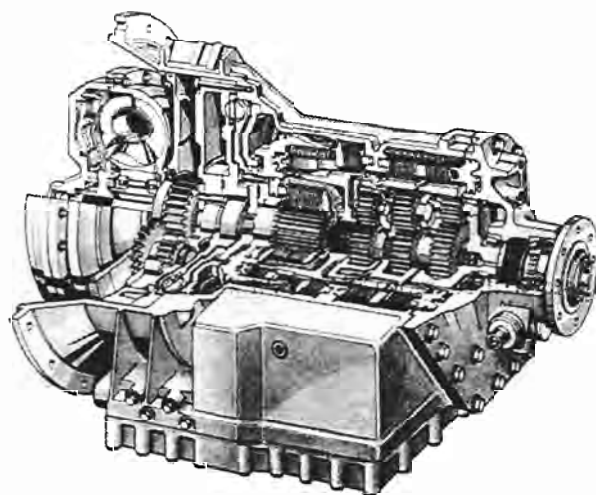




ZF-ECOMAT®

HP 500 / HP 590 / HP 600
EAZ-6 and AEM-6 (12V)
Stages 1 - 2



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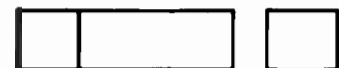
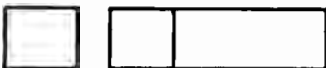
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Contents

Section	Page
Preface	3
Important Safety Information	4
Tightening Torques	5
Adjustment Data and Tightening torques	6
Special Tools	8
Special Notes	10
Cross-Section of Automatic Transmission	11
1. Maintenance	15
1.1 Oil Change Intervals	15
1.2 Oil Capacity	15
1.3 Oil Grade	15
1.4 Oil Level Check	16
1.5 Oil Temperature for Level Check	16
1.6 Adding Oil	16
1.7 Cold Oil Level Check	16
1.8 Oil Level Check at Operating Temperature	17
1.9 Changing Oil	17
1.10 Load Sensor Adjustment	18
2. Field Service Procedures	19
2.1 Removing Oil Drain Plug	19
2.2 Renewing Oil Filter	20
2.3 Renewing Retarder Solenoid Valve	22
2.4 Renewing Accumulator Solenoid Valve	23
2.5 Renewing Accumulator	24
2.6 Renewing Temperature Sensor	25
2.7 Renewing Output Inductive Sensor	26
2.8 Removing and Installing Oil Pan	30
2.9 Renewing Turbine Inductive Sensor	32
2.10 Renewing Complete Hydraulic Transmission Control	38
2.11 Renewing Speedometer Drive	43
2.12 Renewing Output Flange and/or Radial Seal	44
2.13 Pressure Tests	48
Troubleshooting - Allocation of Peripheral Parts	50
Troubleshooting Guide.....	51
Troubleshooting	52
Troubleshooting - Solenoid Valves, Switches and Inductive Sensor	59
Troubleshooting	60
Test Instructions PR-52	61
Instructions for PR-61 Electronic Test Unit	62





Preface

This manual is intended to permit expert maintenance and field service work on the ZF product in question.

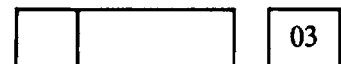
Please note in particular that work on our products must only be carried out in workshops with

1. trained personnel
2. the specified equipment, e.g. special tools, and
3. Genuine ZF Spare Parts.

All work must be performed with maximum care and attention. This applies in particular to the installation of parts from vehicles which have been involved in accidents and which have been damaged by external force. The manufacturer's statutory liability does not cover damage and other consequences resulting from incorrect and inexpert field service work; the same applies if parts other than Genuine ZF Spare Parts have been used.

The unit to be serviced may differ from the standard product for which this manual was compiled in respect of certain procedures and technical data. This manual should therefore only be used by foremen and mechanics who have received supplementary practical and theory training at our Service Training School.

ZAHNRADFABRIK FRIEDRICHSHAFEN AG
Friedrichshafen Business Area
Service





Important Safety Information

The person repairing ZF assemblies is responsible for safety at work in order to prevent personal injury and damage to the vehicle or equipment. The mechanic is responsible for ensuring that all general and specific safety regulations applicable to maintenance and field service work are observed.

The following safety-related headlines are used in this manual to draw your attention to particular points:

WARNING: Used whenever insufficient care could result in personal injury or even loss of life.

CAUTION: Indicates that failure to observe these working procedures, or following the incorrect procedure, could cause damage to the product.

NOTE: Highlights particular procedures, methods, remarks, use of auxiliary aids etc.

The person supervising servicing should be familiarized with these safety guidelines before commencing work; trained assistant personnel must be available.



Manually tightened - threads lubricated

Tightening torques in inch-pounds, foot-pounds and Newton-meters.
Metric standard threads (not applicable to cadmium-plated parts).

SIZE	Quality (Grade)					
	8.8, 8*			10.9, 10*		
	<u>in-lbs</u>	<u>ft-lbs</u>	<u>Nm</u>	<u>in-lbs</u>	<u>ft-lbs</u>	<u>Nm</u>
M5	53	4.4	6.0	75	6.3	8.5
M6	88.5	7.4	10.0	124	10.3	14.0
M8	220	18	25	310	26	35
M10	430	36	49	610	51	69
M12	760	63	86	-	89	120
M14	-	100	135	-	140	190

Reference values according to ZF STANDARD 148, April 1965

- * Quality mark for screws and bolts 8.8 and 10.9
according to DIN 267 page 3
- Quality mark for nuts 8 and 10
according to DIN 267 page 4

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Item	Dimension	Measuring Device	Remarks
Kick-down adjustment at accelerator pedal (gas pedal)	_____	PR-61 Tester or ohmmeter	Check that engine fuel pump reaches full throttle before kick-down switch is actuated (circuit opens).
Internal resistances of solenoid valves for transmission clutches and brakes	R = app. 13 Ohms	Ohmmeter and test cable 1P01 137 002	Resistance increases from app. 13 Ohms at room temperature to app. 15 Ohms when transmission warm.
Internal resistance of inductive sensors _T (speed sensors) n ^T and n _{Abt.}	R = app. 1 080 ± 40 Ohms at 70° F, at 20° C	Ohmmeter	Resistance in Ohms is higher when transmission warm.
Tightening torque of temperature sensor M 14 x 1.5	310 in-lbs 26 ft-lbs 35 Nm	Torque wrench	Renew copper sealing ring 0634 801 038.
Tightening torque of oil drain plug M 22 x 1.5 in oil pan	440 in-lbs 37 ft-lbs 50 Nm	Torque wrench	Renew copper sealing ring 0634 801 074.
Clearance between inductive (speed) and impulse sensors	0.024 - 0.03 0.6 - 0.8 mm	" Depth gauge Measuring rod 1P01 136 639	Adjust clearance with shims.
Tightening torque for inductive sensors (speed sensors)	440 in-lbs 37 ft-lbs 50 Nm	Torque wrench	Do not exceed this value.
Speedometer shaft endplay	0.004 - 0.012 0.1 - 0.3 mm	" Depth gauge	Can also be checked by hand (endplay can be felt).
Speedometer shaft tooth backlash	0.004 - 0.008 0.1 - 0.2 mm	" Detect by hand	Can also be checked by hand (play can be felt).
Speedometer drive connection tightening torque	88 ft-lbs App. 120 Nm	Torque wrench	Renew copper sealing ring.
Installed depth of output flange sealing ring in output cover	0.55 - 0.59" 14 - 15 mm	Depth gauge	Use tool 1X56 136 824.
Internal Resistance of Modulation Valve Solenoid	R = app. 3.4 Ohms	Ohmmeter and Test Cable 1P01 137 002	_____

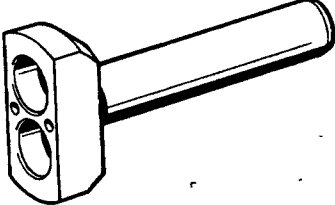
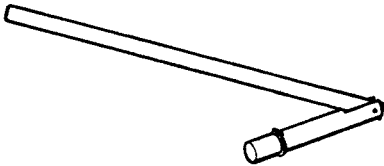
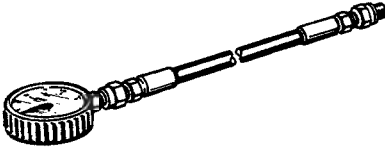
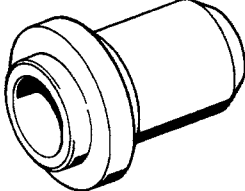
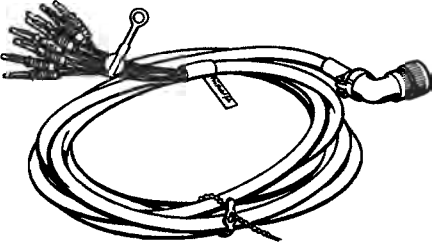
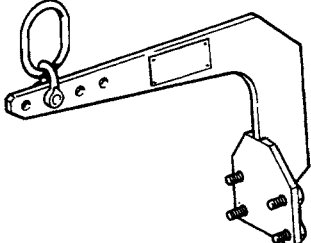


Item	Dimension	Measuring Device	Remarks
Tightening torque of M 6 studs in output cover	55 in-lbs 5 ft-lbs 6 Nm	Torque wrench	_____
Tightening torque of M 10 studs in cover plate	110 in-lbs 9 ft-lbs 13 Nm	Torque wrench	_____
Tightening torque of M 12 studs at output flange	530 in-lbs 44 ft-lbs 60 Nm	Torque wrench	Secure with locking plate. Use tool 1X56 136 471.
Tightening torque of M 42 x 2 sealing plug in channel plate	74 ft-lbs 80-100 Nm	Torque wrench	_____
Tightening torque of drain plug in oil cooler	220 in-lbs 18 ft-lbs 25 Nm	Torque wrench	_____
Tightening torque of M 10 x 1 sealing plugs	130 in-lbs 11 ft-lbs 15 Nm	Torque wrench	Do not exceed this value.

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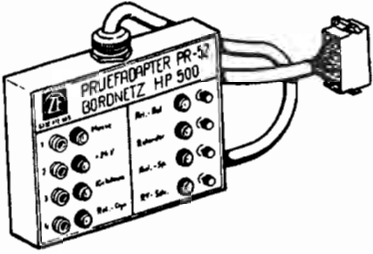

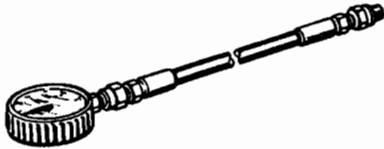
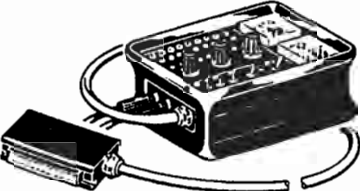
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Item No.	Item	Order No. Use	No.	Remarks
1		1X56 136 471 Adapter for locking plate on output flange	1	
2		1P01 136 639 Measuring rod for inductive sensor (speed sensor) gap adjustment	1	
3		1P01 136 670 Pressure gauge 0 - 25 bar (0 - 356 psi) with M 10 x 1 connection pipe	1	
4		1X56 136 824 Adapter for installing radial sealing ring on output flange	1	
5		1P01 137 002 Test cable for checking solenoid valves	1	
6		1X56 137 126 Transmission hoisting arm	1	





Item No.	Item	Order No. Use	No.	Remarks
7		IP01 137 179 PR-52 test adapter for transmission electrical system	1	
8		6009.020.006 HST-6 auxiliary control box for one forward gear and one reverse gear	1	
9		IP01 137 263 Pressure gauge 0 - 6 bar (0 - 85 psi) with M 10 x 1 connection pipe	1	
10		IP01 137 304 PR-61 test unit for checking transmission and control box	1	



SPECIAL NOTES

Read and observe the following points when using this manual.

CAUTION:

It is vital to observe the tightening torques and adjustment data in this manual. If not otherwise stated, all nuts and screws must be tightened according to the values on pages 2 and 3.

NOTE:

The dimensions of all screws and threads in this transmission are metric. Use only metric wrenches and sockets. Consult the spare parts lists for the sizes and code numbers of bolts.

LAYOUT OF REPAIR INSTRUCTIONS:

The manual is arranged in the order of dismantling. Reassembly is in the reverse order. Deviations are indicated by notes on installing.

NOTE:

An oil-soluble grease such as vaseline should be used. Wheel-bearing or firearm greases containing lithium or graphite compounds must not be used.



Automatic Transmission - Cross Section

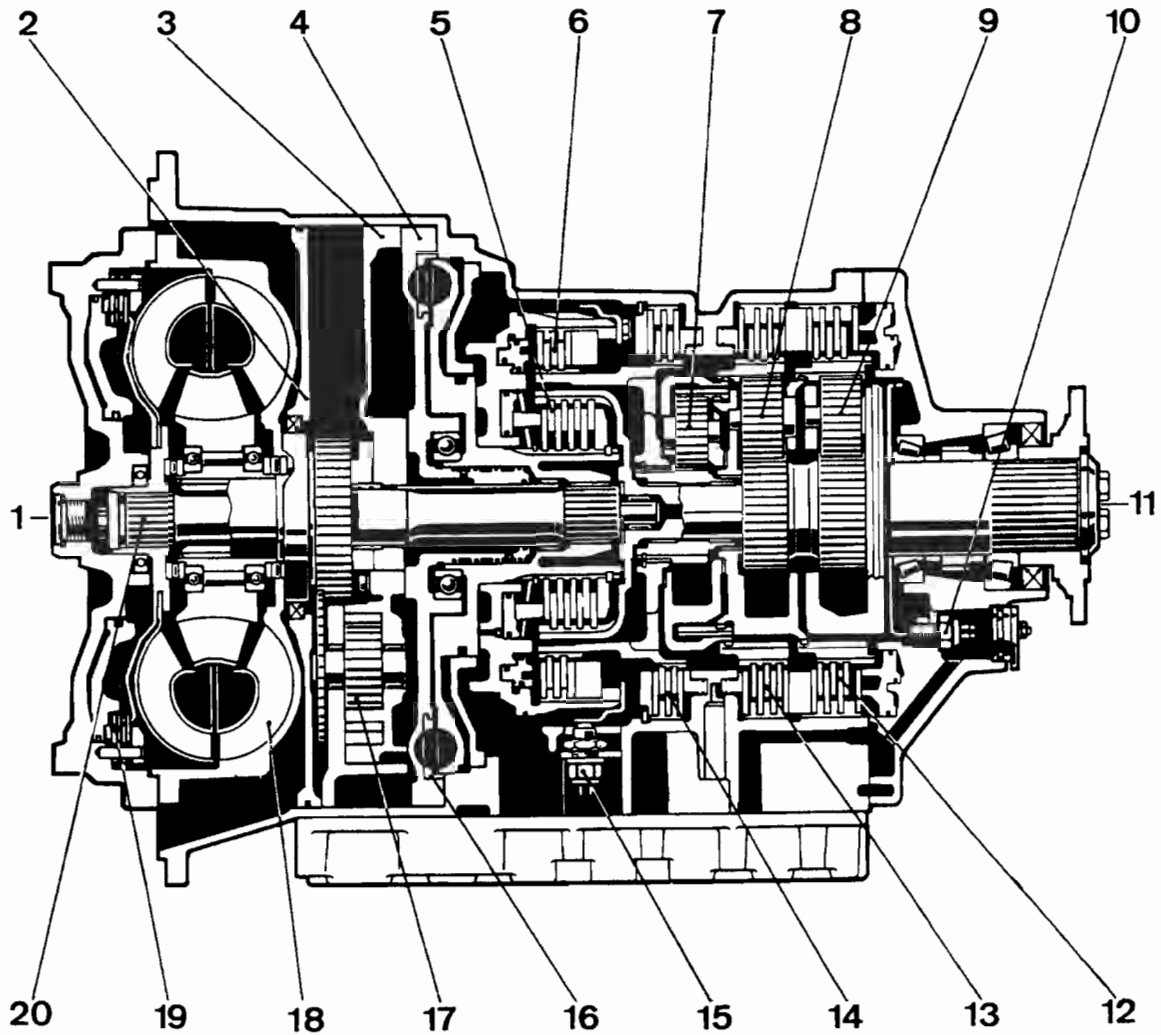


Fig. 1

- | | | | |
|----|------------------------------------|----|----------------------------------|
| 1 | Input | 11 | Output |
| 2 | Cover plate | 12 | Brake "F" |
| 3 | Control element | 13 | Brake "E" |
| 4 | Oil feed flange | 14 | Brake "D" |
| 5 | Clutch "A" | 15 | Inductive sensor (turbine speed) |
| 6 | Clutch "B" | 16 | Retarder |
| 7 | Planetary gear set I | 17 | Primary pump |
| 8 | Planetary gear set II | 18 | Torque converter |
| 9 | Planetary gear set III | 19 | Lockup clutch "H" |
| 10 | Inductive sensor
(output speed) | 20 | Turbine shaft |



5- and 6-speed Automatic Transmission, Design 1 - Cross Section

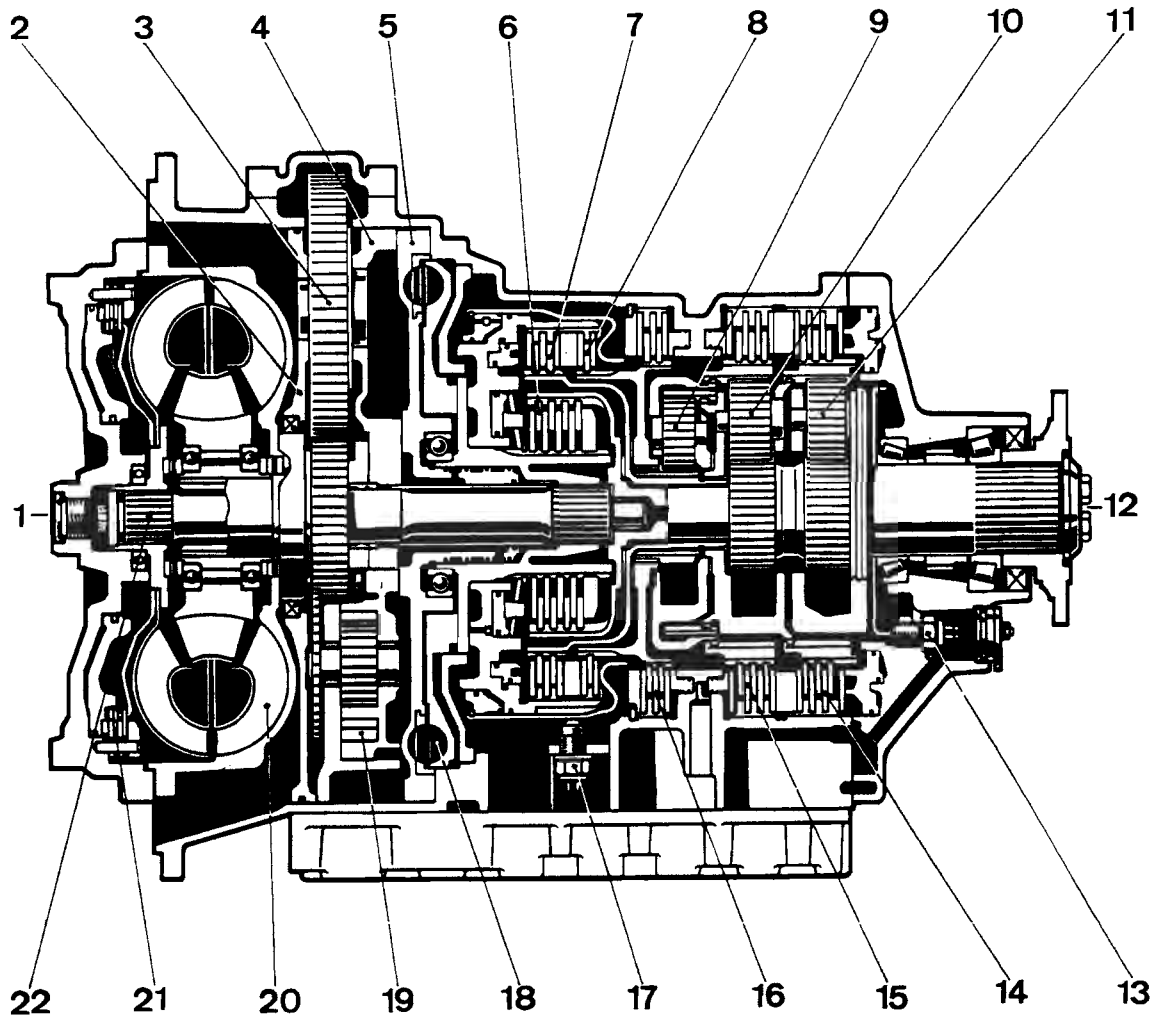


Fig. 1 b

- | | | | |
|----|----------------------------|----|----------------------------------|
| 1 | Input | 13 | Inductive sensor (output speed) |
| 2 | Cover plate | 14 | Brake "F" |
| 3 | Power take-off drive gears | 15 | Brake "E" |
| 4 | Control element | 16 | Brake "D" |
| 5 | Oil feed flange | 17 | Inductive sensor (turbine speed) |
| 6 | Clutch "A" | 18 | Retarder |
| 7 | Clutch "B" | 19 | Primary pump |
| 8 | Clutch "C" | 20 | Torque converter |
| 9 | Planetary gear set I | 21 | Clutch "H" |
| 10 | Planetary gear set II | 22 | Turbine shaft |
| 11 | Planetary gear set III | | |
| 12 | Output | | |



ZF 5- and 6-speed Automatic Transmission, Designs 2 and 3

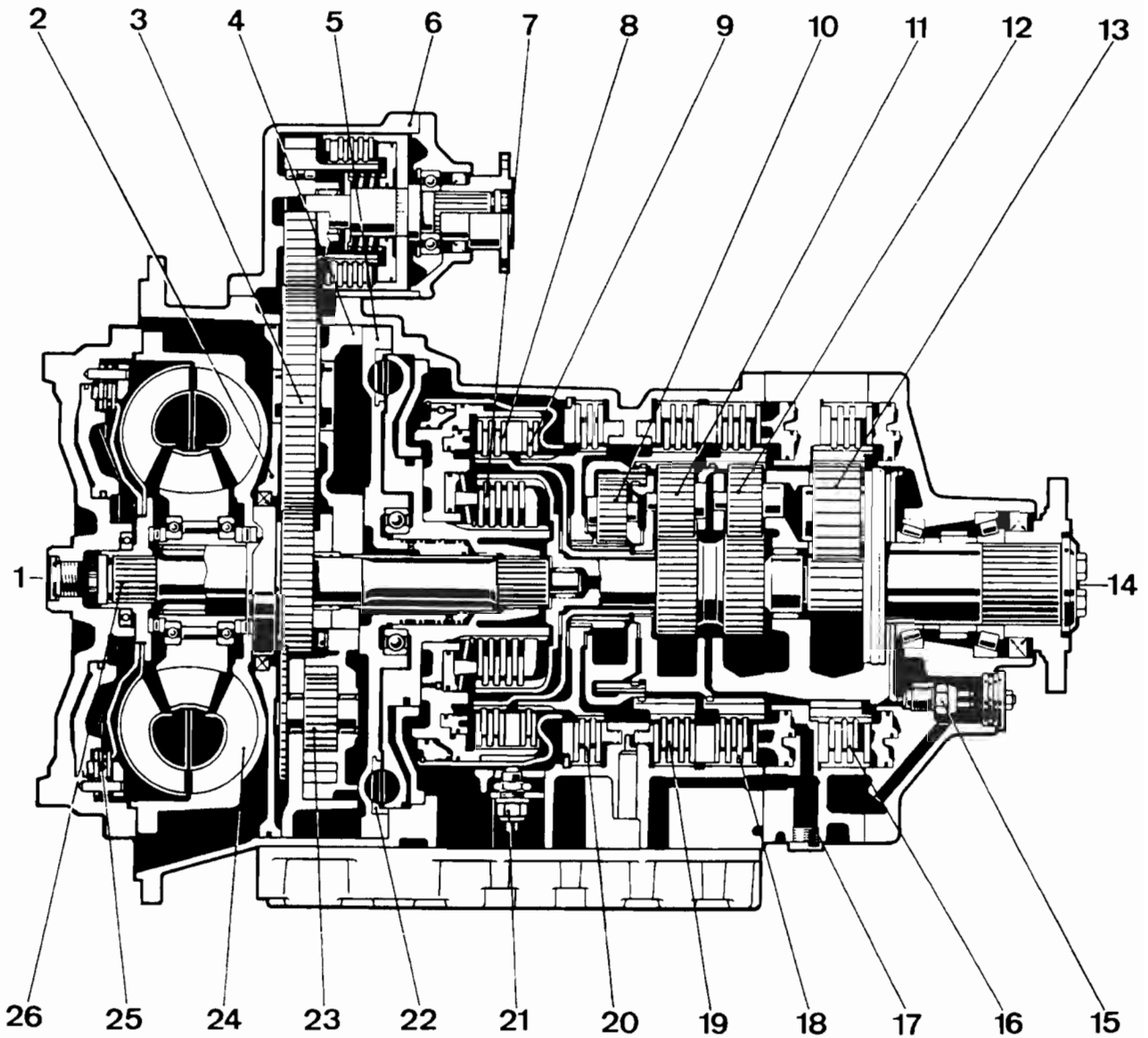


Fig. 1 c

- | | | | |
|----|----------------------------|----|----------------------------------|
| 1 | Input | 15 | Inductive sensor (output speed) |
| 2 | Cover plate | 16 | Brake "G" |
| 3 | Power take-off drive gears | 17 | Pressure measuring point |
| 4 | Control element | 18 | Brake "F" |
| 5 | Oil feed flange | 19 | Brake "E" |
| 6 | Power take-off | 20 | Brake "D" |
| 7 | Clutch "A" | 21 | Inductive sensor (turbine speed) |
| 8 | Clutch "B" | 22 | Retarder |
| 9 | Clutch "C" | 23 | Primary pump |
| 10 | Planetary gear set I | 24 | Torque converter |
| 11 | Planetary gear set II | 25 | Clutch "H" |
| 12 | Planetary gear set III | 26 | Turbine shaft |
| 13 | Planetary gear set IV | | |
| 14 | Output | | |



1. Maintenance

1.1 Oil Change Intervals

NOTE:

- The suction filter must be renewed every time the oil is changed. The oil must first be drained off.
- The complete filter set (filter and gaskets) is available under ZF Order No. 4139 298 936.

Transmission fluid change	Distance	Operating hours
First oil change	600 miles	30 - 60
Oil change every in normal operating conditions	18 000 miles	
Oil change every in all construction machinery or special vehicles, cranes, refuse trucks etc. operated in extreme climatic conditions	12 000 miles	1 000

but at least once a year.

1.2 Oil Capacity

Initial capacity of dry transmission (incl. oil cooler)	app.	8	gal
When refilling after installing transmission in vehicle	app.	5 1/2 - 7	gal
Oil change	app.	4 - 5	gal

The amounts stated serve only as a guideline. The level shown on the dipstick is always decisive.

1.3 Oil Grade

See ZF TE-ML 14 Table of Lubricants. This list is updated yearly.

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1.4 Oil Level Check

- Check the oil level at least once a month.
- The vehicle must be standing level.
- Engine idle position (600 rpm)
- Shift to neutral before measuring.

CAUTION:

It is essential to maintain the correct oil level. An inadequate oil level will lead to faults and transmission failure. Too much oil results in the transmission overheating.

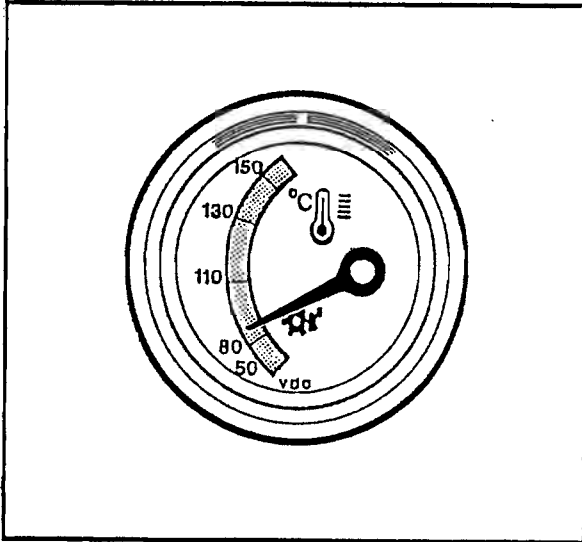


Fig. 11

1.5 Oil Temperature for Level Check

The correct operating temperature for checking the level can be read off the gauge in the vehicle.

NOTE:

For the oil level check, the transmission fluid must have reached an operating temperature of 176 - 194 °F.

1.6 Adding Oil

Add transmission fluid through the same aperture as used for dipstick measurement.

1.06 qts alters the oil level by app. 0.40".

1.7 Cold Oil Level Check.

Conditions:

- Vehicle must be standing level.
- Set shift selector to "N" (neutral)
- Engine idle position (600 rpm)

After idling for 2 to 3 minutes, the transmission fluid level must lie between the lower and upper marks of the cold temperature zone. If below the minimum mark, top up immediately. Adjust the final oil level after checking again at operating temperature.

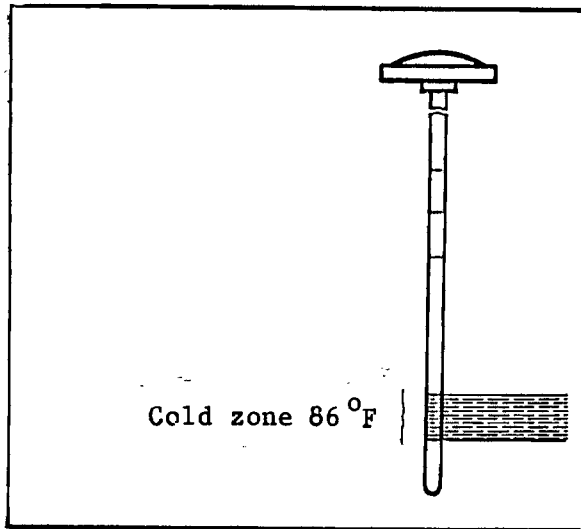


Fig. 12

1.8 Oil Level Check at Operating Temperature

Conditions:

- Vehicle must be standing level.
- Set shift selector to "N" (neutral).
- Engine idle position (600 rpm).

The oil level must lie between the upper and lower marks on the hot temperature zone.

If the oil level does not lie within this range, repeat check and ensure that the cap of the oil dipstick is firmly located in the bayonet cap when the dipstick is introduced.

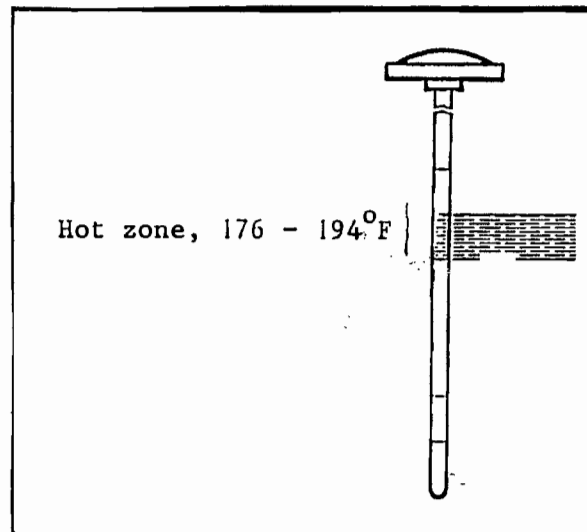


Fig. 13

1.9 Changing Oil

- Switch off engine.
- Drain off transmission fluid at the drain aperture in the oil pan (see Fig. 14).
- Unscrew filter cover and renew suction filter (see section 2.1).
- Screw in drain plug (tightening torque 37 ft-lbs) and fit filter cover (18 ft-lbs) (see sections 2.1 and 2.2).
- Draw out dipstick and add a maximum of 2.6 gallons transmission fluid.
- Start the engine and immediately add 1.1 gallons transmission fluid, pouring in slowly.
- Insert dipstick and check cold oil level (see section 1.7). Adjust if necessary.
- Run the engine to bring the transmission fluid up to operating temperature (176 - 194°F). Check the oil level at operating temperature (see section 1.8) and adjust if necessary.

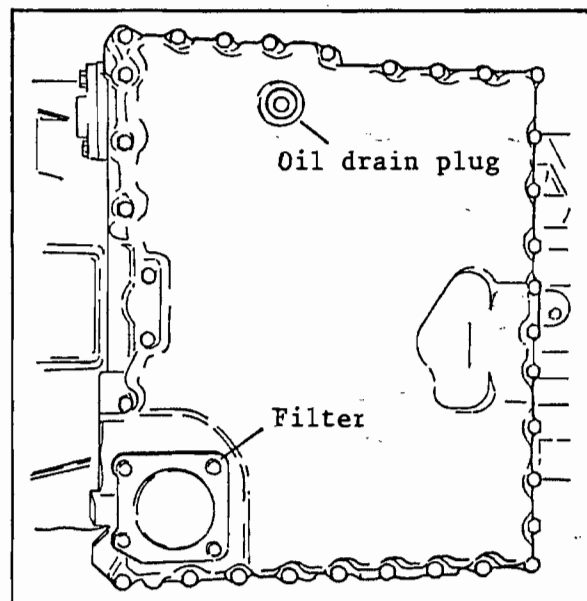
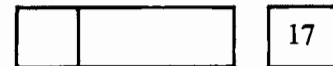


Fig. 14

NOTE:

Further details on maintenance are given in the operating manual for the ZF-ECOMAT series.



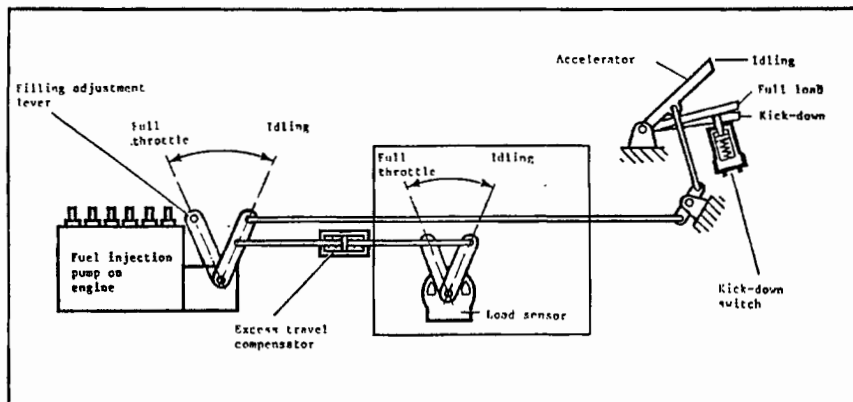


1.10 Load Sensor Adjustment
Version with electric pressure modulation

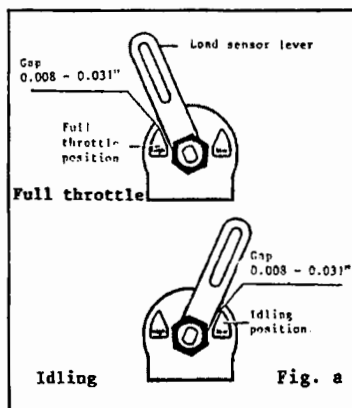
Test every three months at the minimum.
If maladjusted, protracted slip times will result in damage.

WARNING:

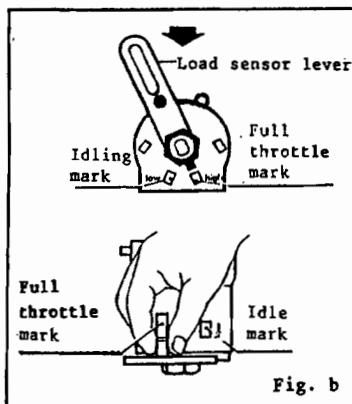
Do not adjust while the engine is running. The engine must be stopped and the ignition turned off.



Versions delivered before June 1987 (Fig. a)



- Turn off engine
- Push accelerator down completely
- Hold in position
- Measure gap between load sensor lever and full-throttle position (desired value: 0.008 - 0.031")
- Release accelerator until idling position is reached
- Measure gap between load sensor lever and idle position (desired value: 0.008 - 0.031")



Versions delivered from June 1987 (Fig. b)

- Turn off engine
- Push accelerator down completely
- Hold in position
- Load sensor lever must correspond to full-throttle mark when felt
- Release accelerator until idling position is reached
- Load sensor lever must correspond to idling mark when felt

Do not use the limit stop for adjustment!





4. Field Service Procedures

4.1 Oil Drain Plug

Location of oil drain plug in transmission (see Fig. 15).

NOTE:

Check that the solenoid insert on the oil drain plug is free from iron particles; wipe clean.

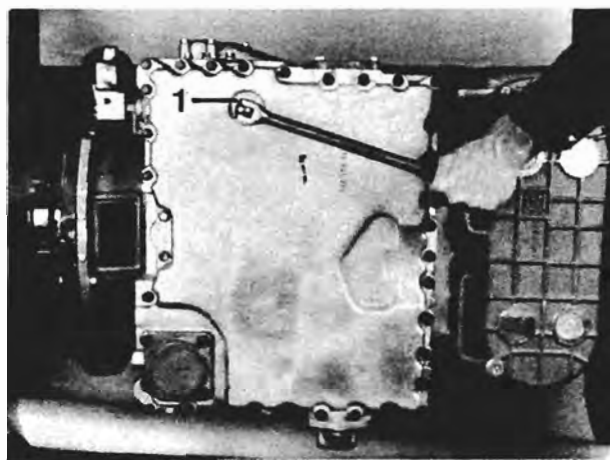


Fig. 15

Renew copper sealing ring (No. 0634 801 074).

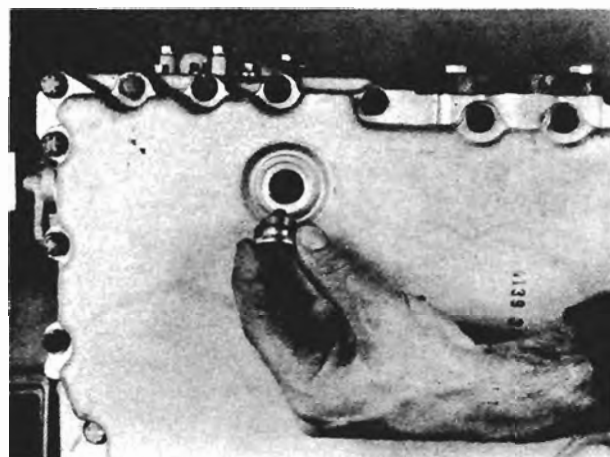


Fig. 16

Tighten oil drain plug with torque wrench. Tightening torque 37 ft-lbs.

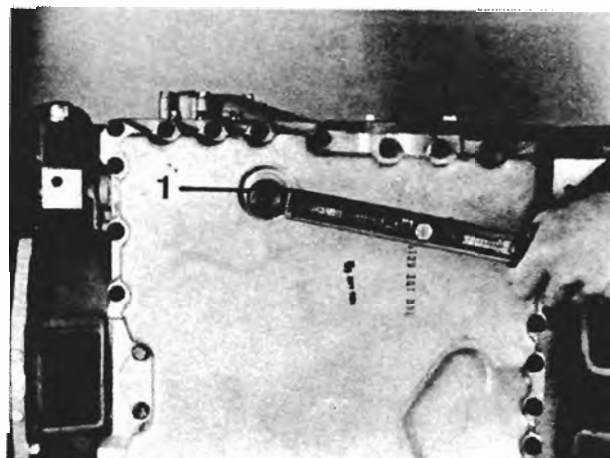
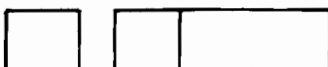


Fig. 17



2.2 Renewing Oil Filter

Remove the four M 8 x 80 mm hex bolts on the oil filter cover with a 13-mm (33/64") hex-socket insert.

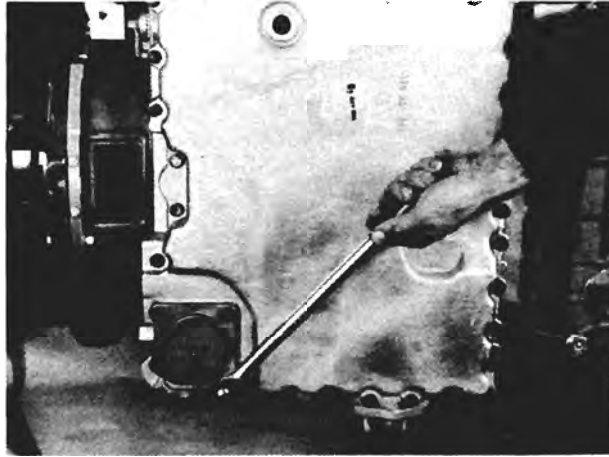


Fig. 18

Pull out old filter element.
Check the filter for contamination.

NOTE:

The filter must always be renewed.

It may not be cleaned for re-use.

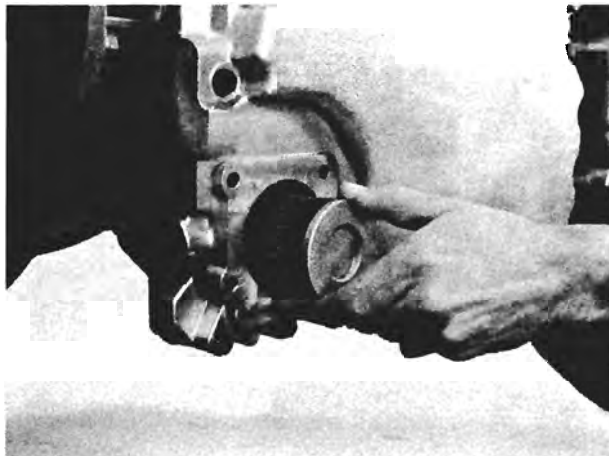


Fig. 19

Use new filter element
(No. 0750 131 003). Check that the
filter O-ring is in place and
undamaged.

Oil the O-ring.



Fig. 20

Push new filter element onto suction tube.

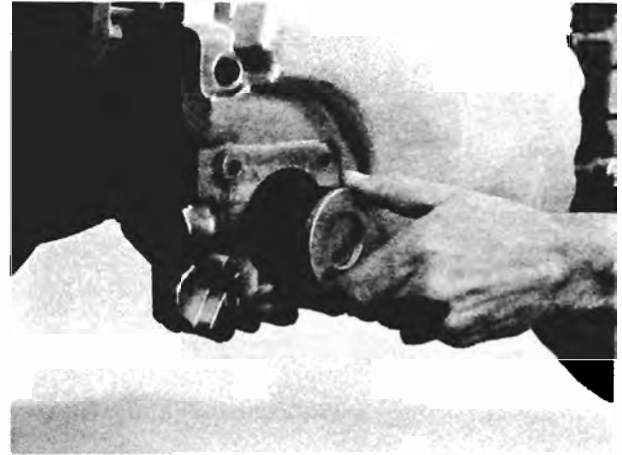


Fig. 21

If the suction tube has been pulled out with the old filter, push back in before fitting the new filter.

Renew O-ring (No. 0634 313 354) acting as a seal between the suction tube and transmission. Before fitting the suction tube, coat the O-ring with vaseline and place in position.

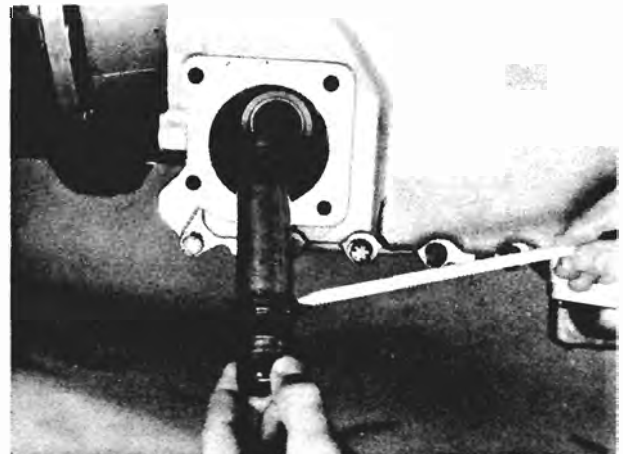
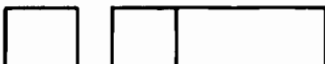


Fig. 22

Renew O-ring (No. 0634 313 018) in filter cap and fit lid again.



Fig. 23



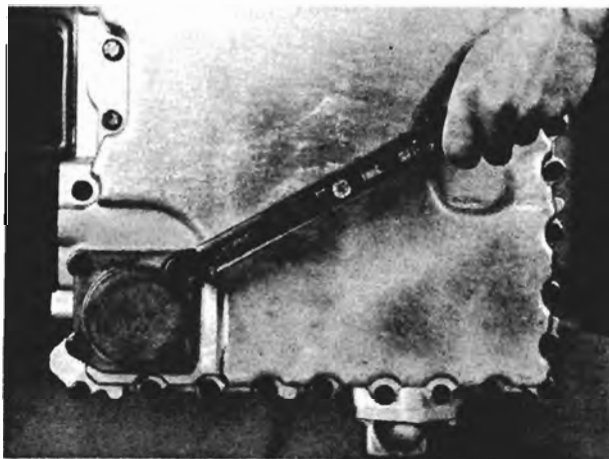


Fig. 24

Tighten the four hex bolts to 18 ft-lbs. Use a torque wrench with 13 mm (33/64") hex-socket insert. See section 1.6 for filling with transmission fluid.

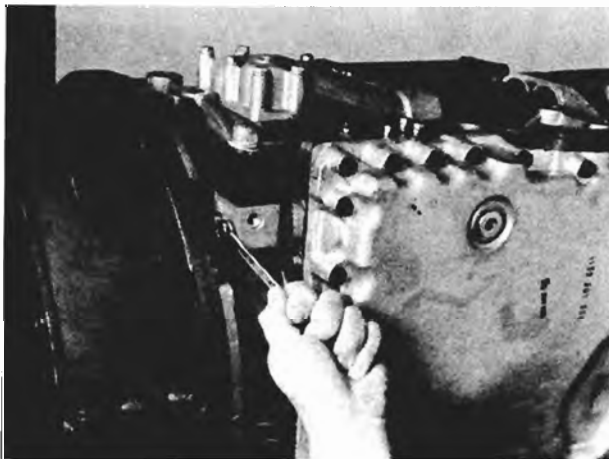


Fig. 25

2.3 Renewing Retarder Solenoid Valve

Unscrew the 2-wire cable connector on the solenoid valve. Disconnect the air line.

Remove the two M 8 x 55 mm hex bolts with 13-mm (33/64") hex-socket insert.



Fig. 26

Grease a new O-ring and insert into the groove of the solenoid valve. Fit the valve.

Tighten both M 8 x 55 mm hex bolts to 18 ft-lbs.

Reconnect the air line and MV-1 cable connector.

2.4 Renewing Accumulator Solenoid Valve

Unscrew the 2-wire cable connector from the solenoid valve.
Disconnect the air line.

Unscrew both M 8 x 55 mm hex bolts.

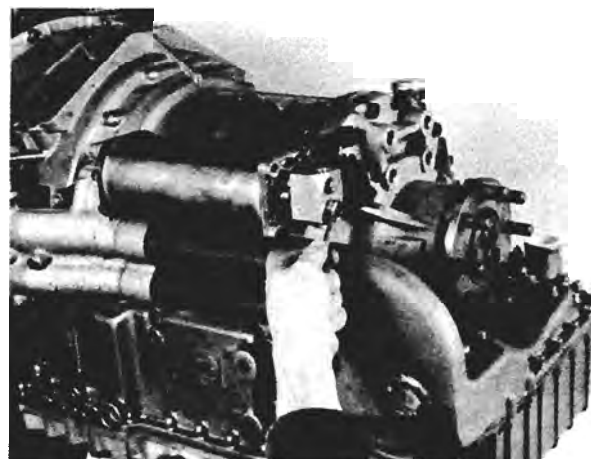


Fig. 27

Grease a new O-ring and insert in the groove on the solenoid valve.
Fit the valve.

Tighten the two M 8 x 55 mm hex bolts to 18 ft-lbs.

Reconnect the air hose and MV-2 cable connector.



Fig. 28



Fig. 29

2.5 Renewing Accumulator

Remove the accumulator solenoid valve according to section 2.4.

Unscrew the two M 8 x 25 mm bolts at the output end of the accumulator.

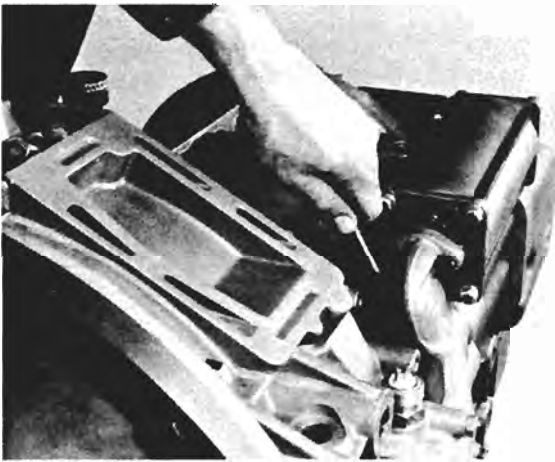


Fig. 30

Remove the two M 8 x 25 mm hex-socket bolts on the input end of the accumulator with a 6 mm (15/64") allen screw.



Fig. 31

Insert new O-ring in the groove on the accumulator.

Insert the accumulator and both M 8 x 25 mm hex-socket bolts with washers. Tighten to 18 ft-lbs.

Insert both M 8 x 25 hex bolts, nuts and washers at the rear of the accumulator. Tighten to 18 ft-lbs.

2.6 Renewing Temperature Sensor

Unscrew the 2-wire cable connector on the temperature sensor.

Unscrew the temperature sensor with a 27 mm (1 1/16") hex-socket insert element.

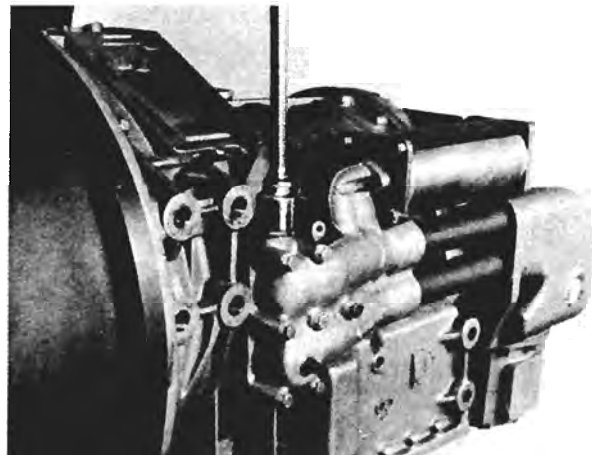


Fig. 32

Push new copper sealing ring onto temperature sensor.
Tighten to 26 ft-lbs.

Reconnect the 2-wire cable connector labeled "TG".

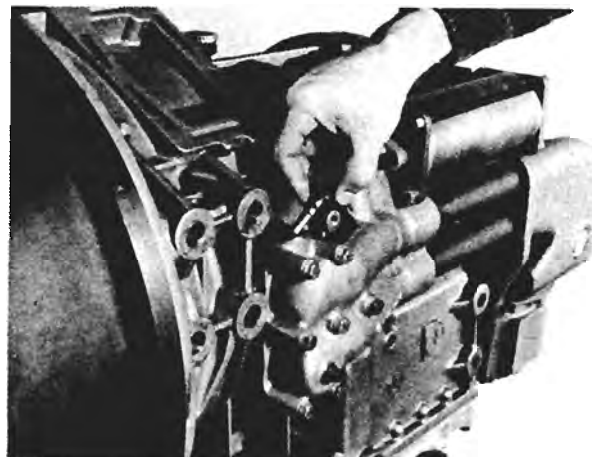


Fig. 33

2.7 Renewing Output Inductive Sensor

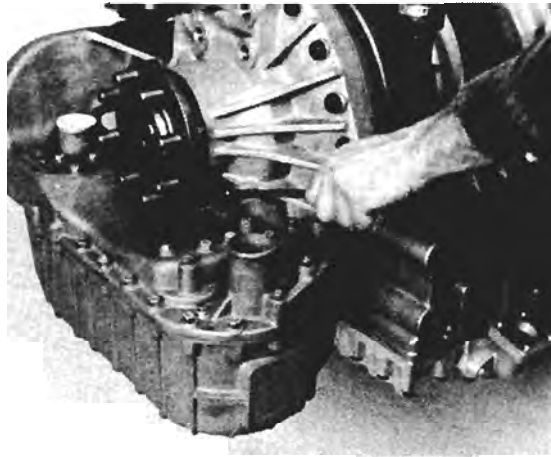


Fig. 34

Remove the two M 6 nuts and washers on the cover with 10-mm (25/64") hex-socket insert.

Pull off cover by hand.

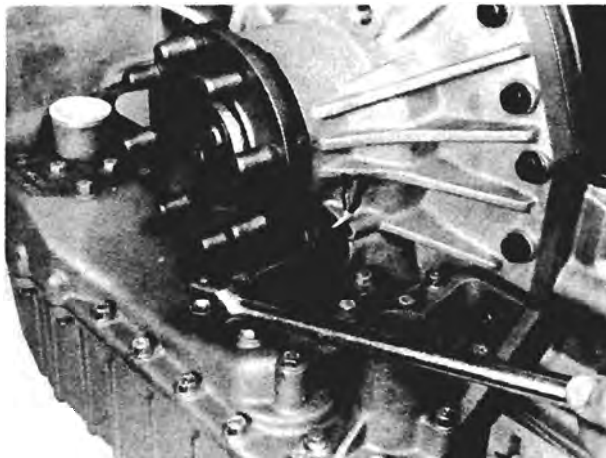


Fig. 35

Disconnect the two wires from the inductive sensor. These are flat spade connectors which pull straight out.

Unscrew the inductive sensor with a socket wrench.

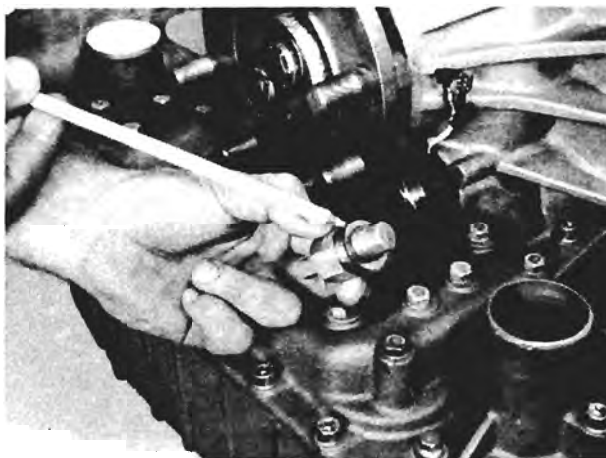


Fig. 36

Ensure that all shims are removed from under the inductive sensor.

Slide the snap ring app. 0.236" onto measuring tool 1P01 136 639.

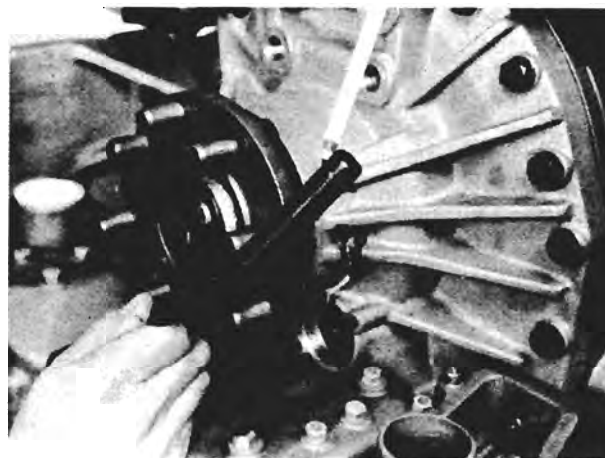


Fig. 37

Push measuring tool 1P01 136 639 straight into the inductive sensor hole, sliding the snap ring back until the tool reaches the end.

Pull the measuring tool out carefully so as not to displace the snap ring.

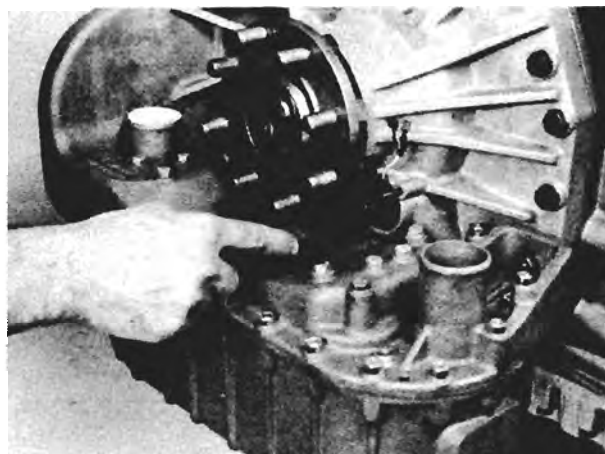


Fig. 38

Measure the distance from the end of the measuring rod to the snap ring and note down.

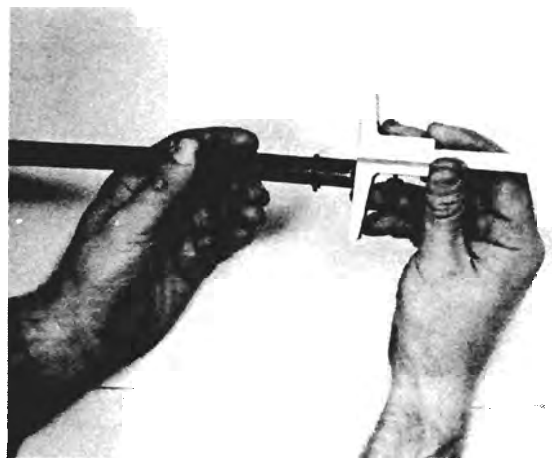
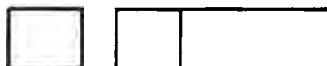


Fig. 39



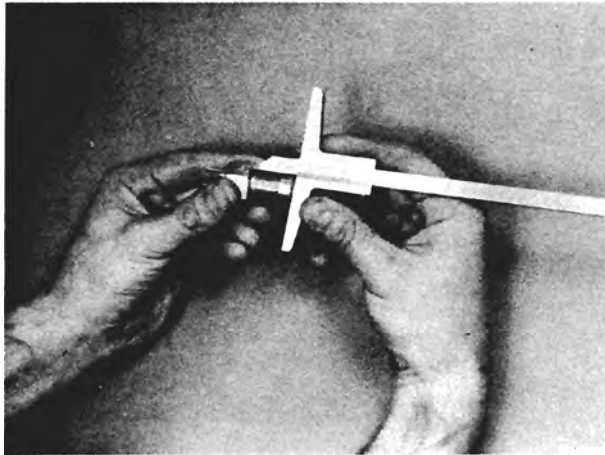
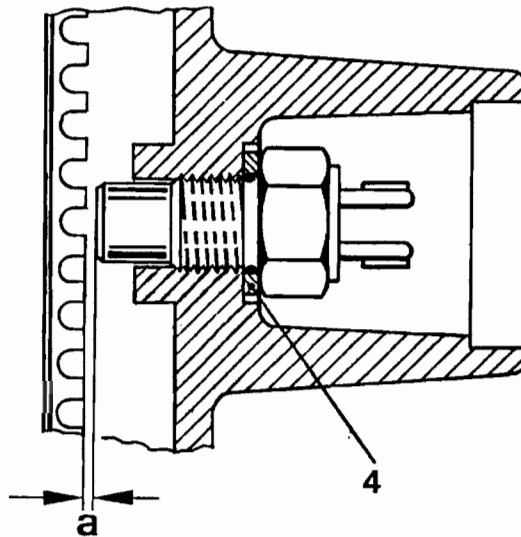


Fig. 40

Measure the inductive sensor from the contact surface to the surface for the shims. Note down the measurement.



The inductive sensor requires a gap of 0.024 - 0.031" for correct operation.

Shims "4" are used to adjust gap "a".

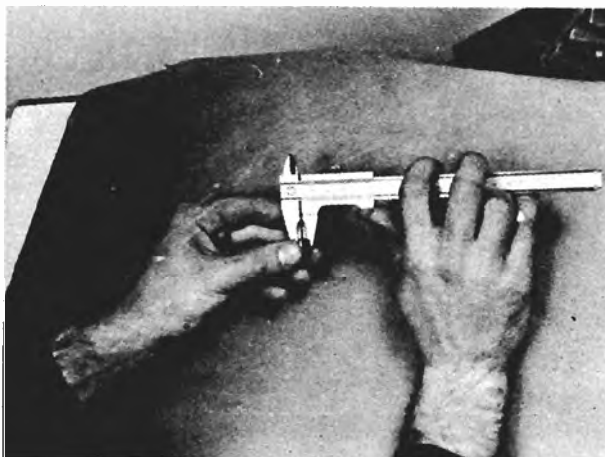


Fig. 42

Deduct the length of the measuring tool from the length of the inductive sensor. The result, plus the sensor gap (0.024 - 0.031"), represents the thickness of the shims used in Fig. 43.

Shims are available in the thicknesses stated in Fig. 65.

Push the selected shims onto the inductive sensor and thread into place.



Fig. 43

Tighten the inductive sensor to 37 ft-lbs with a torque wrench. Do not exceed this value.

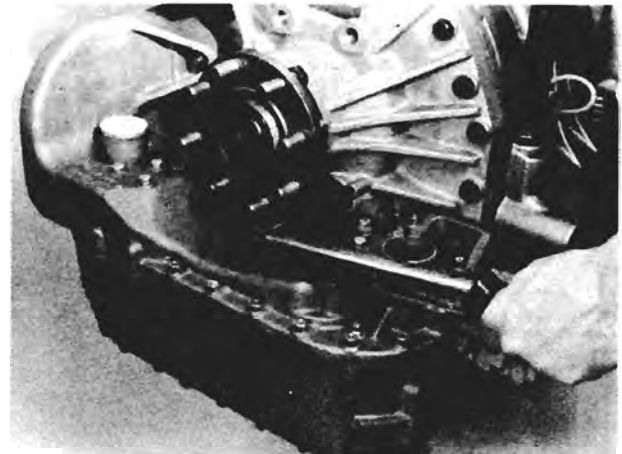


Fig. 44

Plug the wire connectors into the inductive sensor. The pole arrangement on the inductive sensor is irrelevant.

Renew the O-ring on the cover and tighten the cover with two M 6 nuts and washers. Only tighten to 4.4 ft-lbs.

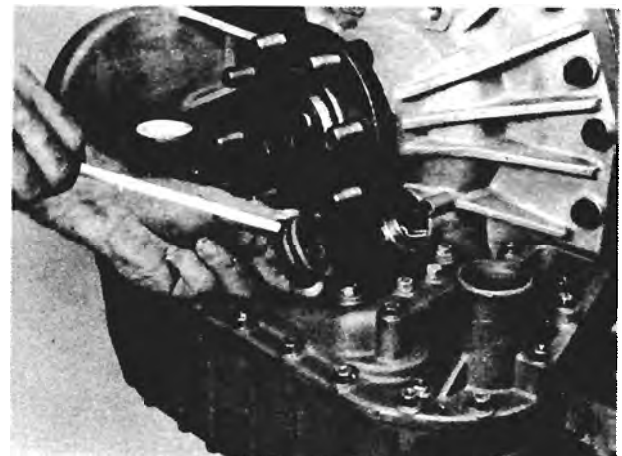


Fig. 45

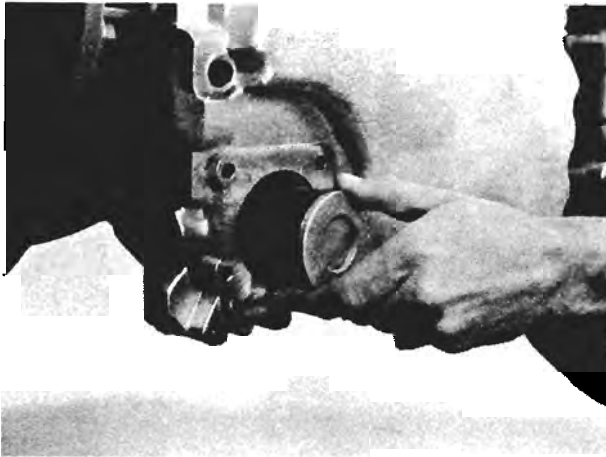


Fig. 46

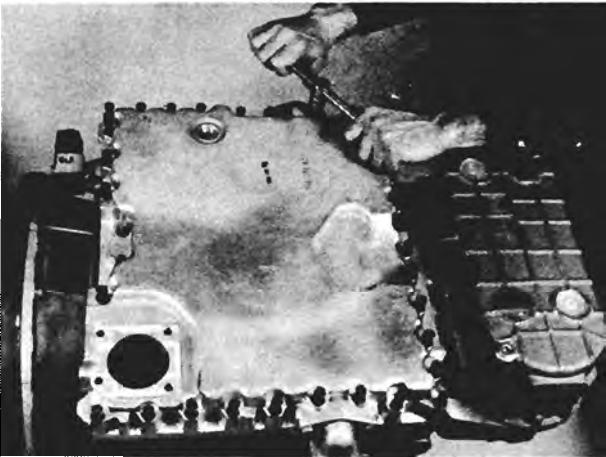


Fig. 47

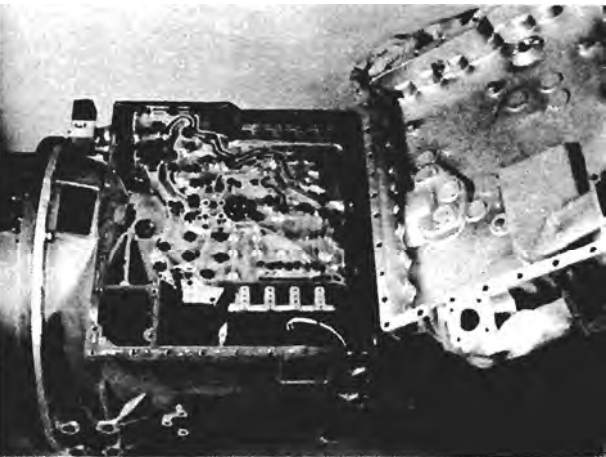


Fig. 48

2.8 Removing and Installing Oil Pan

Drain off oil and remove oil filter according to procedure described in sections 2.1 and 2.2.

Remove all 29 M 8 x 60 mm hex bolts on the oil pan.

Loosen the seal around the oil pan by tapping gently with a plastic mallet.

WARNING:

Make sure that the oil pan is well supported so that it cannot suddenly drop.

Remove oil pan.

Install new gasket on transmission housing before fitting the oil pan.

The two hex bolts at the front of the oil pan in the center require copper washers (No. 0634 803 003). The remaining hex bolts require only steel washers.



Fig. 49

Tighten M 8 x 60 mm hex bolts on the oil pan to 18 ft-lbs.



Fig. 50

Refit oil drain plug as described in section 2.1.

Renew oil filter and fill transmission fluid as described in sections 1. and 2.2.

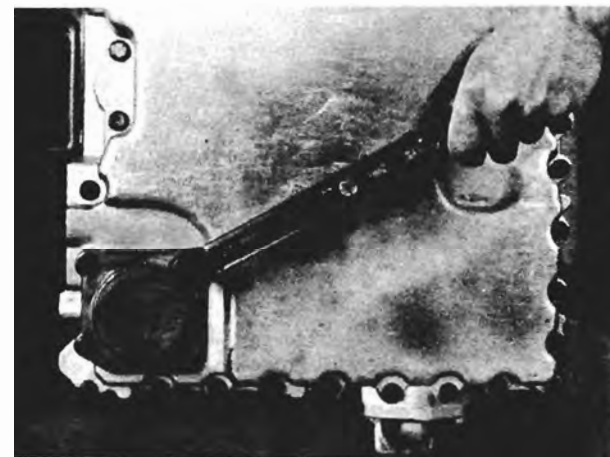


Fig. 51





2.9 Renewing Turbine Inductive Sensor

Remove oil pan as described in section 2.8.

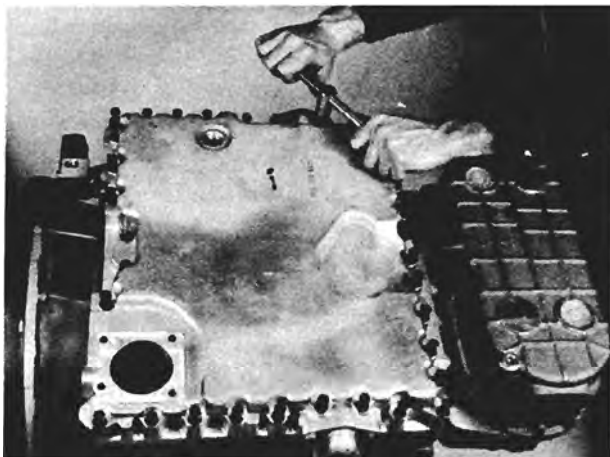


Fig. 52

Remove M 42 x 2 stop plug with Allen key.

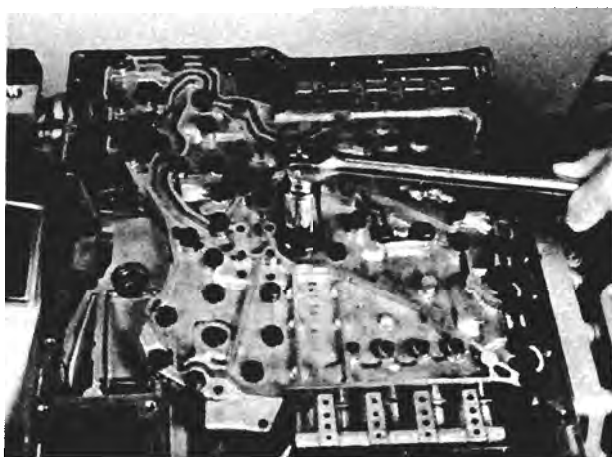


Fig. 53

Remove both cable connectors from the inductive sensor. These flat spade connectors can be pulled straight out.

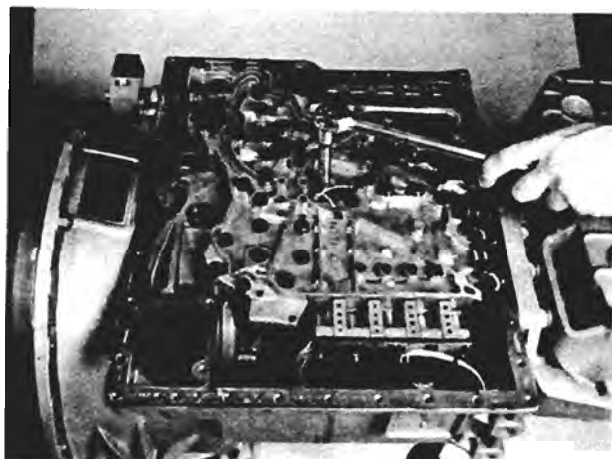
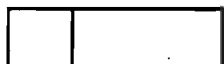


Fig. 54





Ensure that all shims beneath the inductive sensor have been removed. The bottom shim tends to stick to the retaining plate.

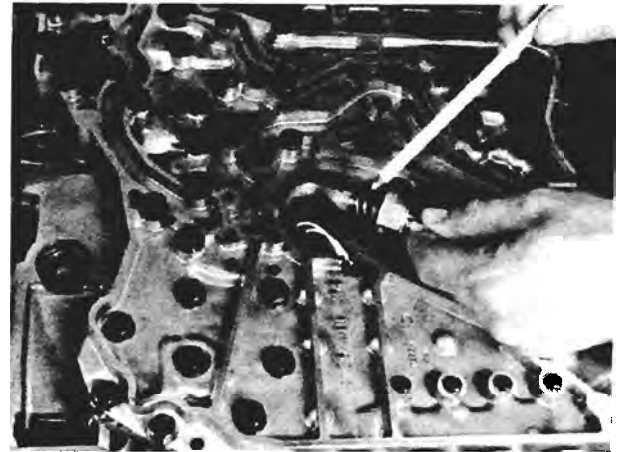


Fig. 55

Turn the torque converter with a large screwdriver or similar tool, simultaneously securing the raised areas on the impulse sensor ring with a small screwdriver.



Fig. 56

Stop turning the torque converter once one of these raised areas is located below the screw hole on the inductive sensor. Measure distance "a" between inductive sensor "3" and one raised area on impulse sensor ring "1".

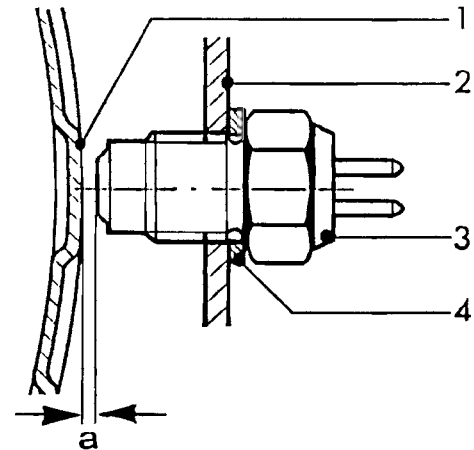


Fig. 57

CAUTION:

It is important that a raised area on the impulse sensor ring should be located directly below the threaded hole for the inductive sensor when taking this measurement. If the measurement is taken from a depression in the impulse sensor ring, the inductive sensor will be damaged by the raised areas on the sensor ring when the engine is started.

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Slide the snap ring app. 0.3" onto measuring tool 1P01 136 639.



Fig. 58

Push measuring tool 1P01 136 639 straight into the inductive sensor hole until it reaches the impulse sensor ring.

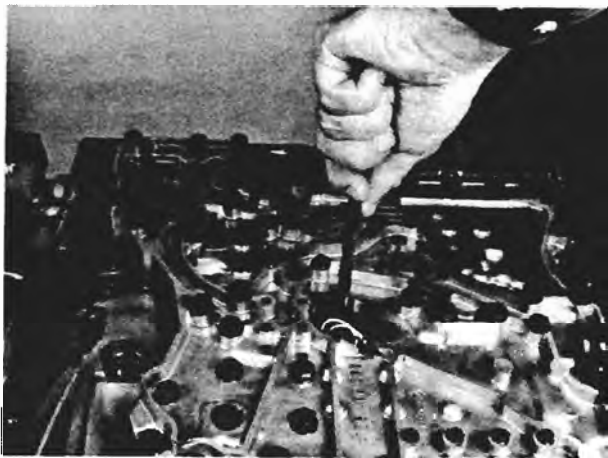


Fig. 59

Snap ring "4" of measuring tool "3" is pushed back in the measuring process and makes contact with retaining plate "2".
"1" = impulse sensor ring.

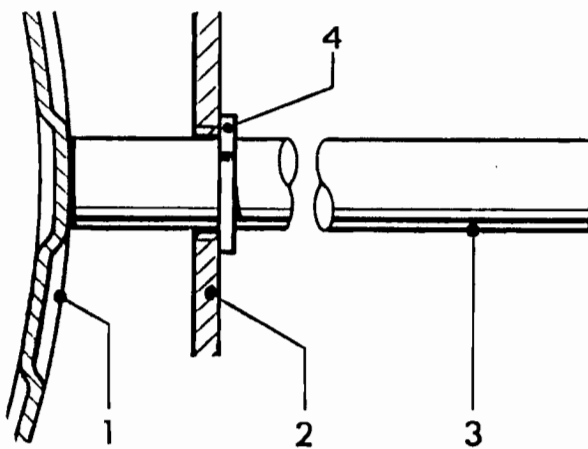


Fig. 60

Pull the measuring tool out carefully so as not to displace the snap ring.



Fig. 61

Measure the distance from the end of the measuring rod to the snap ring and note down.

Carry out the above measuring process at several points on the circumference of the impulse sensor and calculate the average value.

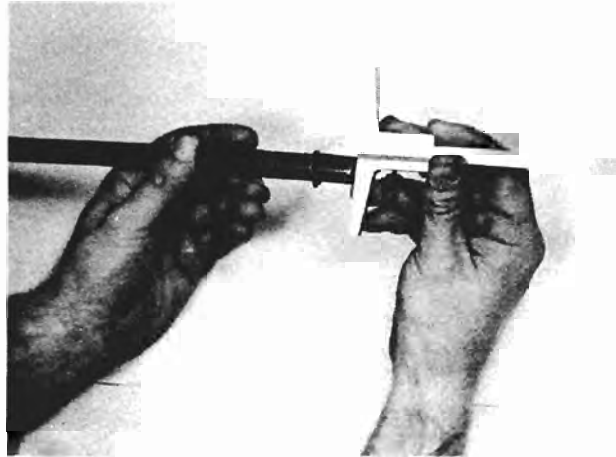


Fig. 62

Measure the inductive sensor from the contact surface to its tip for the shims. Note down distance.

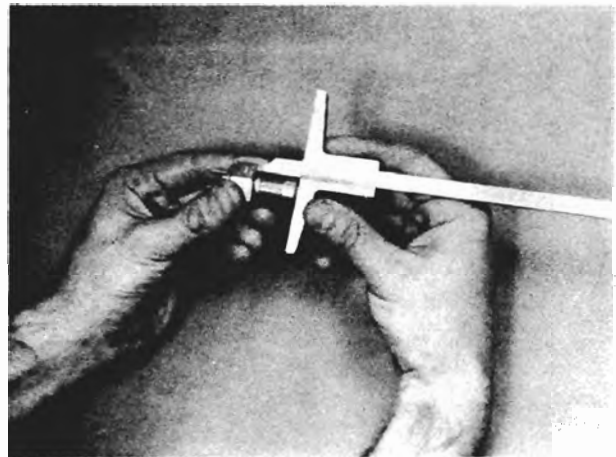


Fig. 63

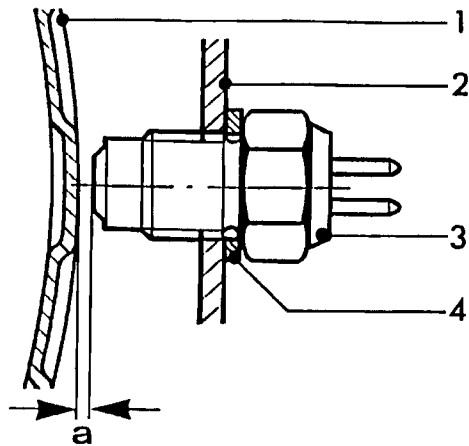


Fig. 64

The inductive sensor requires a gap of 0.024 - 0.031" for correct operation.

Shims "4" are used to adjust gap "a".

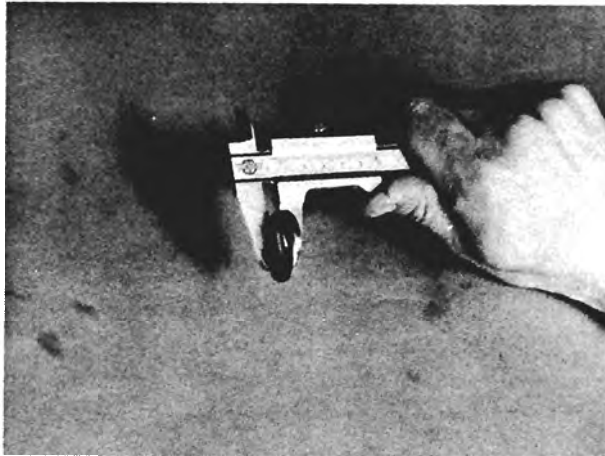


Fig. 65

Deduct the length of the measuring tool from the length of the inductive sensor. The result, plus the sensor gap (0.024 - 0.031), represents the thickness of the shims used in Fig. 66.

Shims are available in the following thicknesses:

0730 003 049	= 0.024"	(0.6 mm)
0730 003 050	= 0.031"	(0.8 mm)
0730 002 069	= 0.040"	(1.0 mm)
0730 002 068	= 0.047"	(1.2 mm)
0730 002 067	= 0.055"	(1.4 mm)
0730 002 066	= 0.062"	(1.6 mm)
0730 002 065	= 0.070"	(1.8 mm)
0730 002 064	= 0.078"	(2.0 mm)
0730 002 063	= 0.086"	(2.2 mm)
0730 002 062	= 0.094"	(2.4 mm)
0730 002 061	= 0.102"	(2.6 mm)
0730 003 299	= 0.110"	(2.8 mm)
0730 003 300	= 0.118"	(3.0 mm)

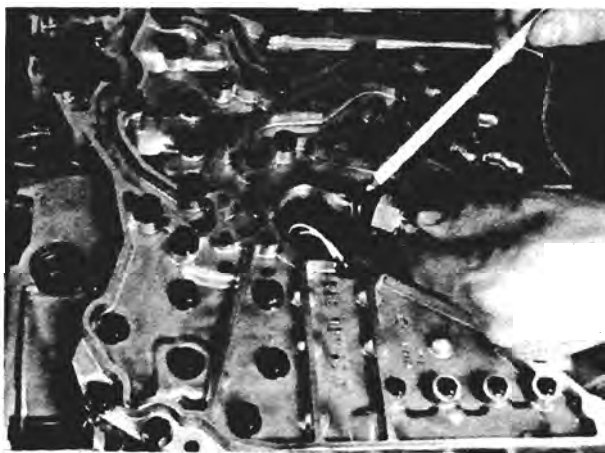


Fig. 66

Push the selected shims onto the inductive sensor and thread into place.

Tighten the inductive sensor to 37 ft-lbs with a torque wrench. Do not overrun the groove.

Plug both wire connectors into the inductive sensor. The pole arrangement on the inductive sensor is irrelevant.

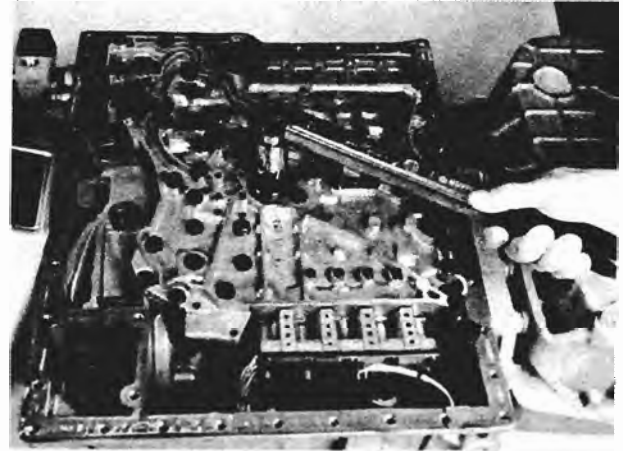


Fig. 67

Insert M 42 x 2 screw plug into the duct plate and tighten to 74 ft-lbs.

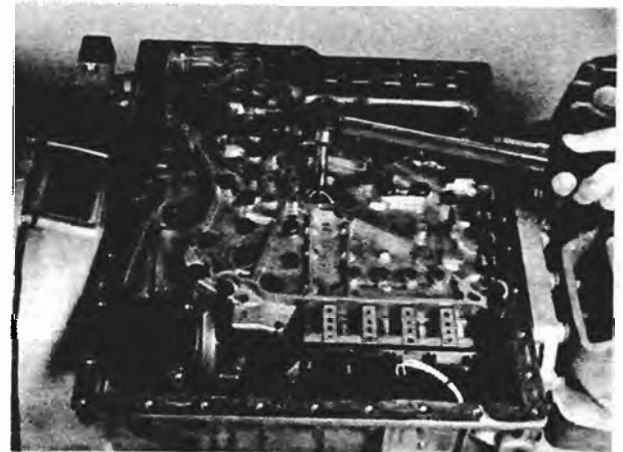


Fig. 68

Insert oil pan again as described in section 2.8.

Insert oil drain plug again as described in section 2.1.

Renew oil filter and transmission fluid as described in sections 1. and 2.2.

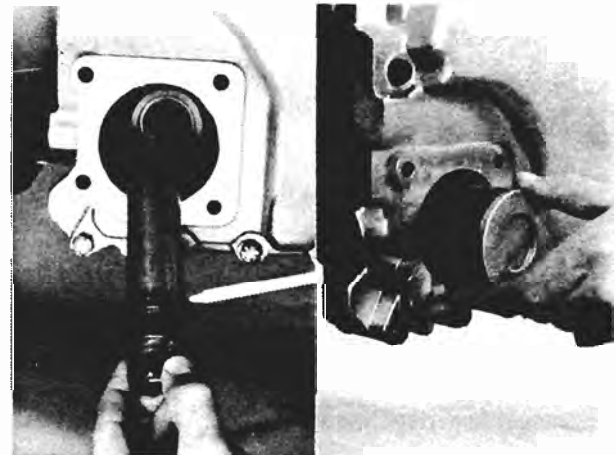


Fig. 69



2.10' Renewing Complete Hydraulic Transmission Control



Fig. 70

Clean dirt and dust from connection between wiring harness and transmission.

Remove plug by turning locking ring clockwise.

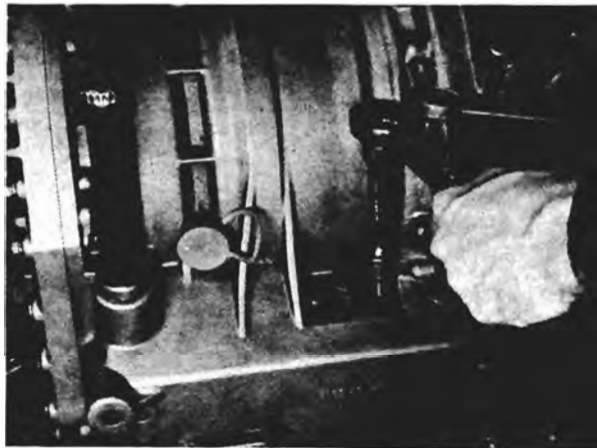


Fig. 71

Unscrew both M 8 x 28 hex screws and washers securing the CANNON socket on the transmission housing.

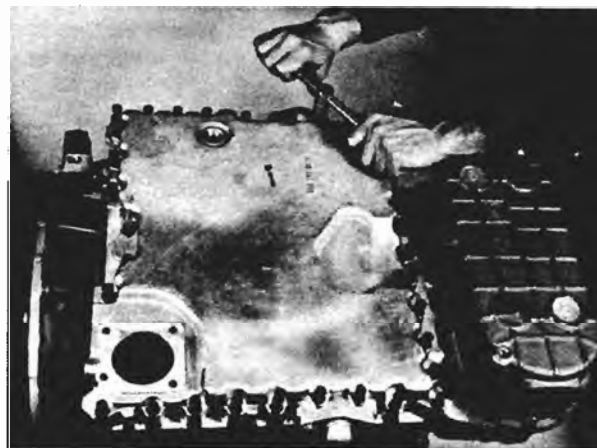
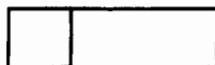


Fig. 72

Remove oil pan as described in section 2.8.



Lever out the 2-wire plug on the valve body with a screwdriver.

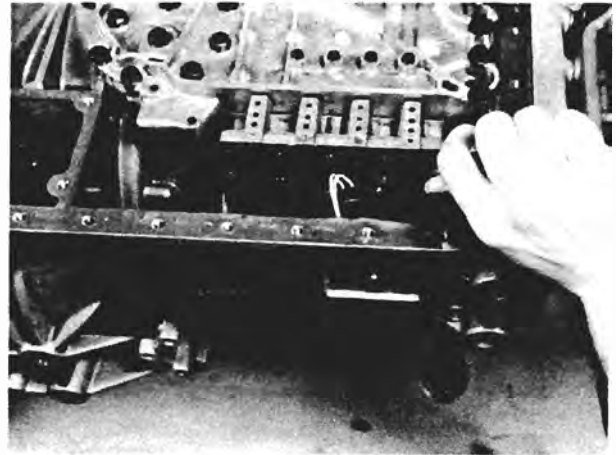


Fig. 73

Separate the 2-pole flat plug from its bushing.

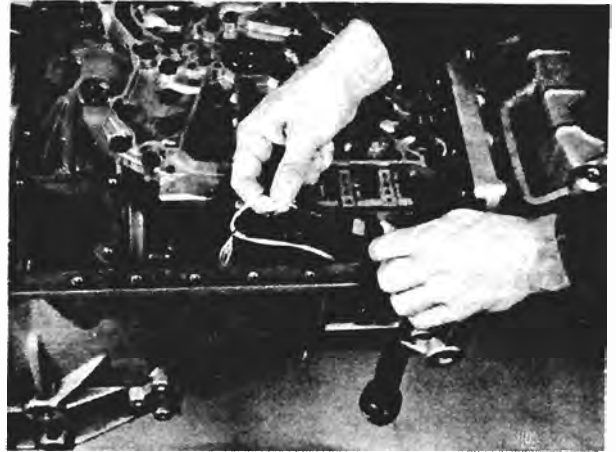


Fig. 74

Without removing, loosen all 39 M 8 hex bolts holding the transmission control in the transmission housing, using a 13 mm (33/64") socket insert.

IMPORTANT:

Do not loosen or remove any M 5 and M 6 hex bolts.

WARNING:

The transmission control weighs app. 40 lbs. It must be supported securely so that it cannot fall and injure you or any others working under the vehicle.

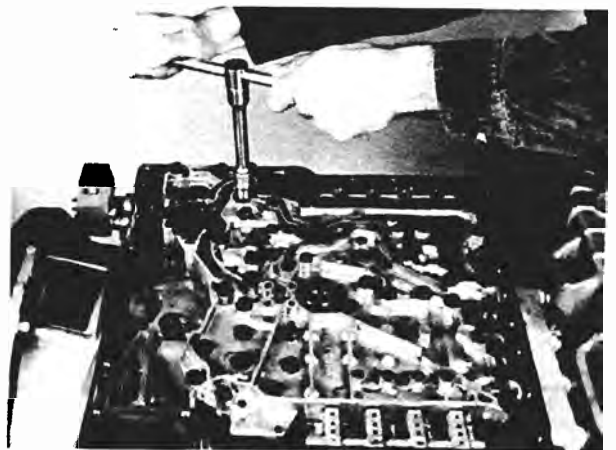
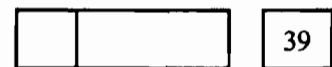
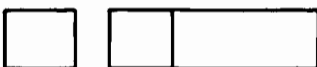
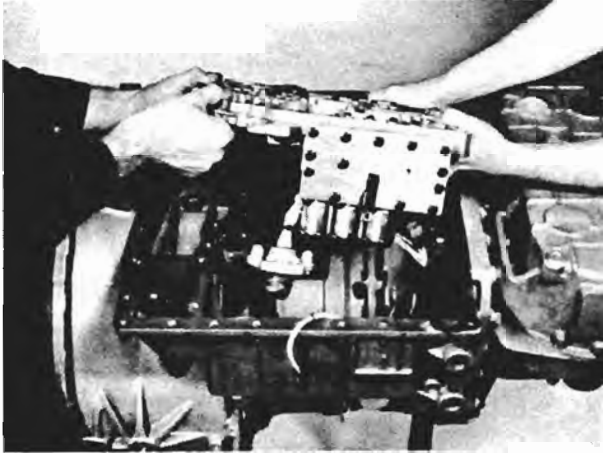


Fig. 75



**WARNING:**

A large amount of oil will pour out when the transmission control is released. Protect yourself, especially the eyes, against splashing oil.



Remove the M 8 hex bolts and lift the transmission control out of the transmission housing.

CAUTION:

Ensure that the cable connectors on the transmission control do not become tangled in the transmission and are torn out.

Fig. 76

To reinstall the transmission control, follow the above description in reverse order, noting the following points:

The inductive sensor gap must only be reset if the transmission control has been renewed. Before fitting the transmission control, remove the inductive sensor. See section 2.9.

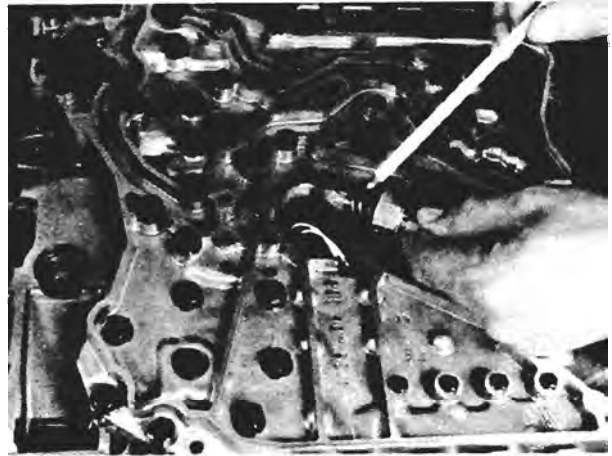


Fig. 77

The 39 M 8 hex bolts holding the transmission control are of two different lengths (1.771 and 1.377").

The nine shorter hex bolts are inserted in the depressions. Ensure that all bolts are accompanied by washers.

Tighten all 39 M 8 hex bolts to 18 ft-lbs.

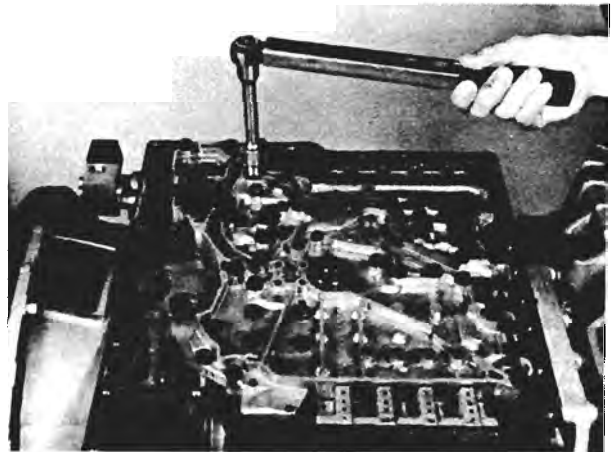


Fig. 78





Insert the plug connection in the corresponding opening in the housing, fit both M 6 x 20 mm hex bolts with washers and tighten to 18 ft-lbs.

NOTE:

Insert the plug connection into the opening in the housing in such a way that the projecting guide of the CANNON socket points towards the output.



Fig. 79

Plug in the flat plug for wiring-harness inductive sensor at the side of the transmission control. Ensure that the projecting guide points in the correct direction.

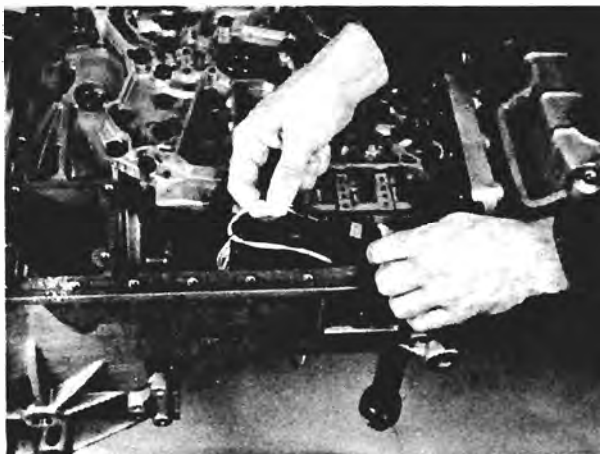


Fig. 80

Measure inductive sensor as described in section 2.9, refit with a fresh washer and connect up again.
Install oil pan and new filter as described in section 2.8.

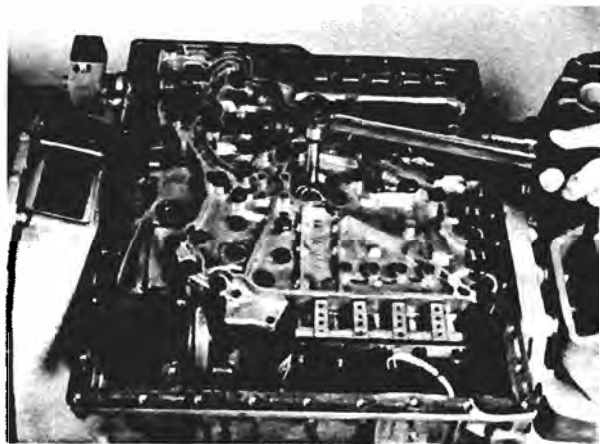


Fig. 81



2.11 Renewing Speedometer Drive

Release speedometer drive with 27 mm (1 1/4") hex-socket insert and remove.



Fig. 82

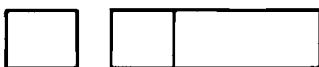
Push new copper sealing ring onto speedometer drive.

Oil the thread and screw in speedometer drive.

Tighten the speedometer drive to app. 79 ft-lbs.



Fig. 83





2.12 Renewing Output Flange and/or Radial Seal

Disconnect propeller shaft from drive flange.
Remove lock plate at output flange.

WARNING:

Wear protective glasses as metal chips may fly off.



Fig. 84

Remove both M 12 x 30 hex bolts from the output shaft with a socket wrench.

Grip the output flange with a suitable lever to prevent it from turning.

It may be necessary to tap the pressure plate with a plastic mallet.

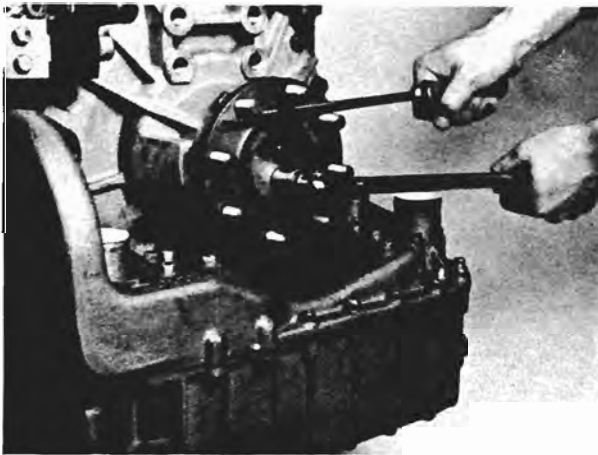


Fig. 85

Pull the output flange off the output shaft with a standard two-arm puller.

NOTE:

Protect the end of the output shaft with a washer or similar (see Fig. 86).

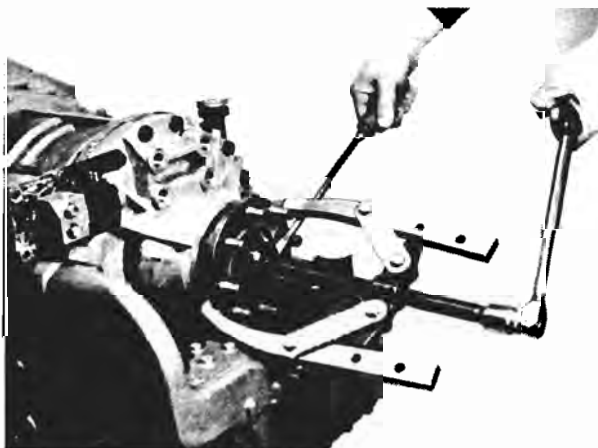


Fig. 86

Pull out the radial sealing ring on the output shaft with a suitable puller.

IMPORTANT:

Do not damage the seal bore when pulling out the sealing ring.

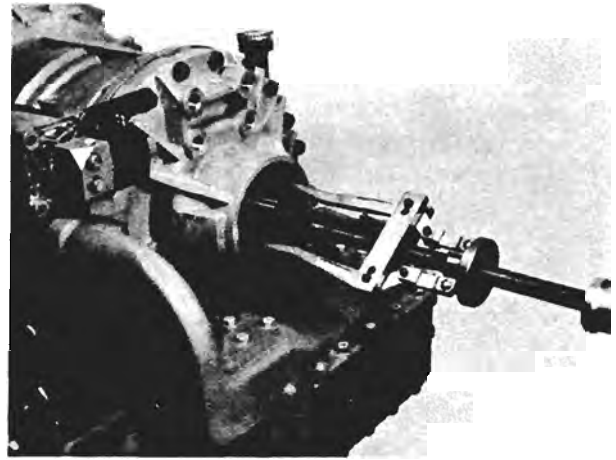


Fig. 87

Fit new radial sealing ring with seal lip pointing towards output cover on tool 1X56 136 824.

IMPORTANT:

Do not apply sealing ring incorrectly. The sprung load in the seal lip should be visible when the sealing ring is fitted to the tool.



Fig. 88

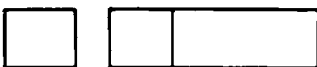
Wet the outer edge of the radial sealing ring with lubricant, e.g. concentrated liquid dishwashing detergent.

IMPORTANT:

Do not use grease or transmission fluid on the outer surface of the sealing ring as this may cause leaks.



Fig. 89

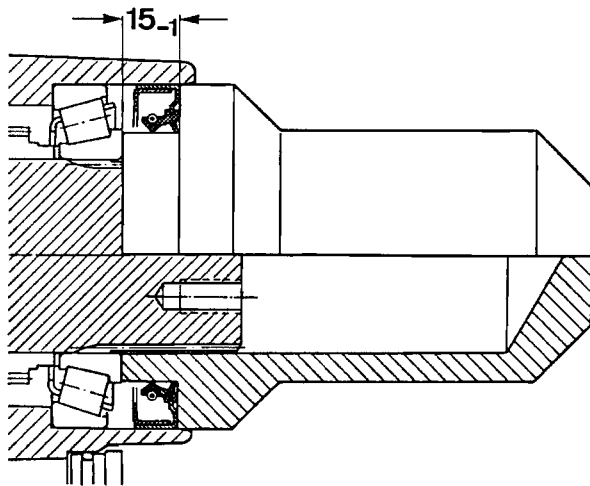




Tap in the radial sealing ring with tool 1X56 136 824 until it is fully on.



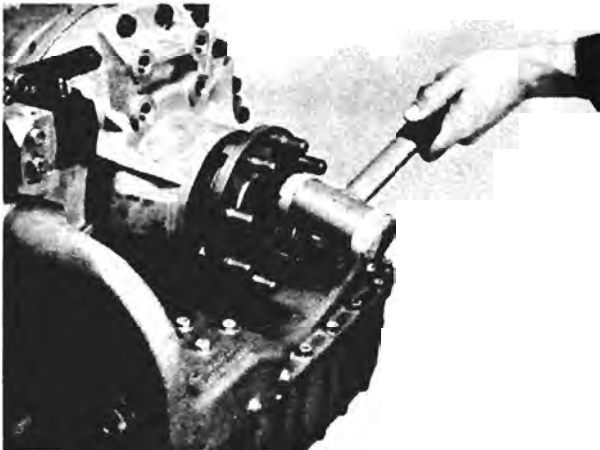
Fig. 90



Tool 1X56 136 824 locates the sealing ring 0.590 - 0.039" from the end face of the bearing inner race to the end face of the sealing ring.

Fill the space between the seal lip and dust protection lip with grease.

Fig. 91



Warm output the flange up to 220 - 230°F.

IMPORTANT:

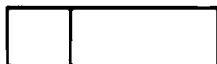
Do not heat the output shaft above 230°F as this will damage the sealing ring.

Push on the flange until it is fully on.

NOTE:

Insert hex bolts before assembling the flange.

Fig. 92





Coat pressure plate on sealing surface (flat area excluding inclined sections) with sealing compound and fit on flange.

NOTE:

The inner surface is flat, and the outer surface beveled.



Fig. 93

Insert M 12 x 30 mm hex bolts. Tighten to 44 ft-lbs.

NOTE:

Always use new hex bolts.

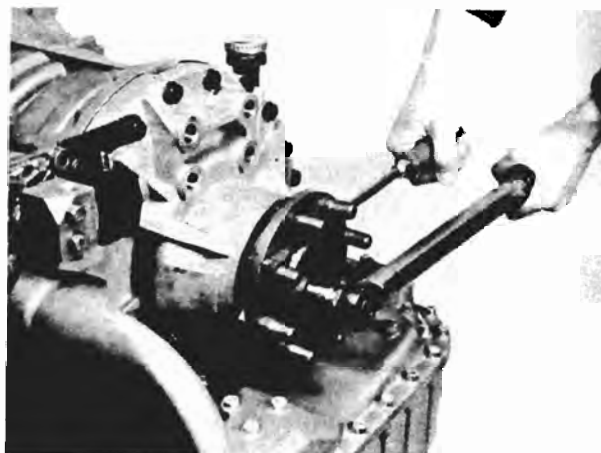


Fig. 94

Push lock plate with tool 1X56 136 471 onto M 12 hex bolts until the lock plate lies flush against the sealing ring.

Tighten propeller shaft again. Tighten hex bolts to the torques recommended by the vehicle manufacturer.

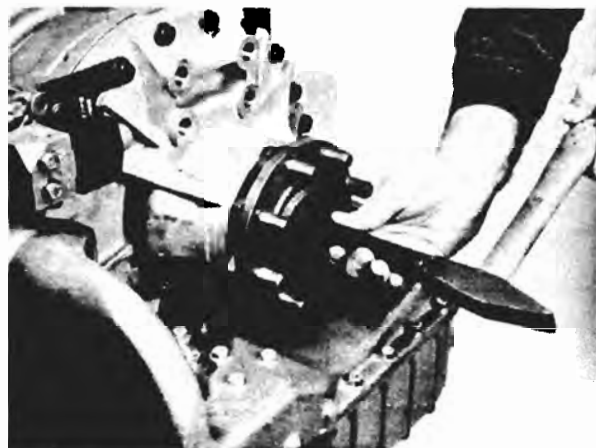
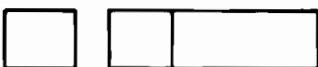


Fig. 95





4.13 Pressure Tests

Pressure tests on a transmission installed in vehicle:
 Remove screw plugs acc. to Fig. 96.
 Connect up pressure gauge and conduct pressure testing according to the table below.

Pressure testing gauges IPO1 136 670 and IPO1 137 263

Pressure measuring point:

- 1 = Pressure measuring point (main pressure) P_H
- 2 = Pressure measuring point (throttle pressure) P_{D1}
- 3 = Pressure measuring point (pressure before converter) P_{bc}
- 4 = Pressure measuring point (lube oil pressure) $P_{lub.}$
- 5 = Pressure measuring point (retarder pressure) $P_{ret.}$

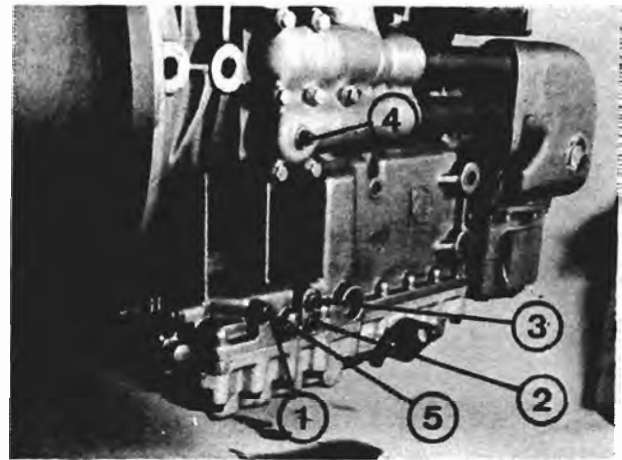


Fig. 96

<u>Pressure measuring table</u>				6	1	2*	3	4	5*
					M 10x1	M 10x1	M 10x1	M 10x1	M 10x1
Load	Gear	Lockup	Engine rpm	Oil temp. (°F)	P_H psi	P_{D1} psi	P_{bc} psi	$P_{lub.}$ psi	$P_{ret.}$ psi
Idling	N - D	diseng.	≈700	70-100	116 - 260		60-80	10-25	
Full load	N	diseng.	2000-2500	70-100	260-300		87-130	25-35	
Full load	engaged	engaged	2000-2500	70-100	145-175		87-130	25-40	
Idling	N - D	diseng.	≈700	176-194	116 - 260		43-62	10-25	
Full load	N	diseng.	2000-2500	176-194	245-290		87-130	10-25	
Full load	engaged	engaged	2000-2500	176-194	145-175		87-130	10-25	

* Consult the appropriate data sheet for values, or consult ZF if necessary.

After completing pressure testing work, disconnect the pressure testing gauge.
Insert the screw plugs and tighten to max. 11 ft-lbs.

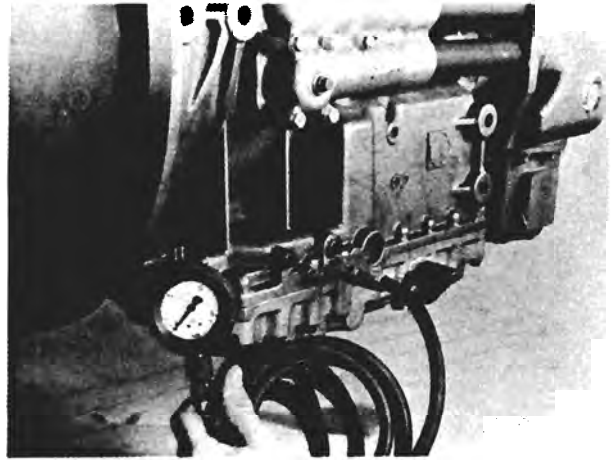


Fig. 97





Allocation of Peripheral Parts

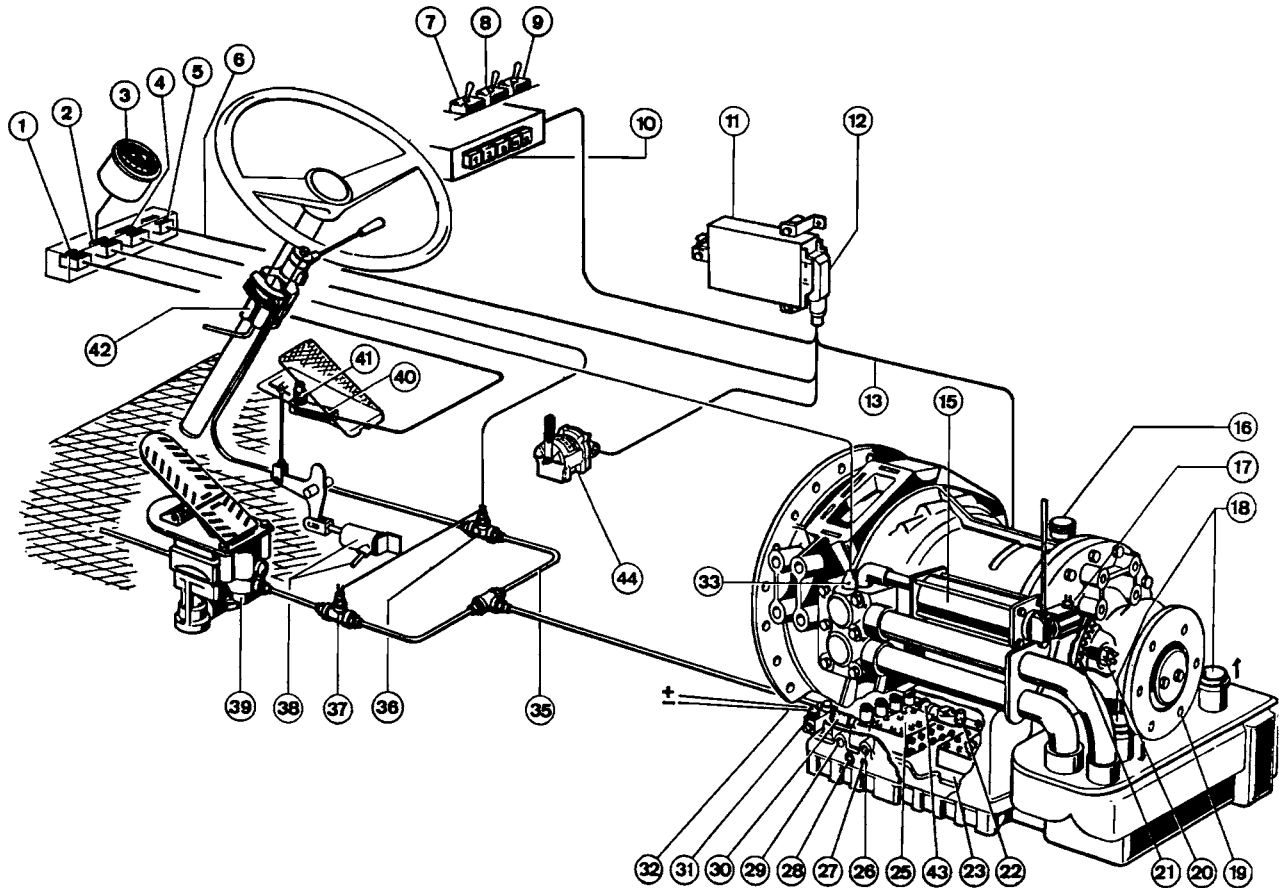


Fig. 2

- | | |
|--|---|
| 1 = Relay | 18 = Coolant connections |
| 2 = Relay | 19 = Output |
| 3 = Temperature display instrument | 20 = Inductive sensor output |
| 4 = Relay | 21 = Ring gear |
| 5 = Relay | 22 = Inductive sensor turbine |
| 6 = Input from vehicle's electrical system | 23 = Hydraulic control |
| 7 = Retarder on/off switch | 25 = Solenoid valves |
| 8 = Power take-off switch | 26 = Pressure measuring point (pressure before converter) |
| 9 = Emergency switch | 27 = Pressure measuring point (throttle pressure) |
| 10 = Transmission shift selector | 28 = Pressure measuring point (retarder pressure) |
| 11 = AEM 6 electronic control unit | 29 = Pressure measuring point (main pressure) |
| 12 = Plug connection | 30 = Retarder control valve |
| 13 = Electric cable connecting control unit and transmission | 31 = Solenoid valve for retarder operation |
| 14 = Pressure modulation lever | 32 = Electrical connection to solenoid valve |
| 15 = Tank for retarder filling | 33 = Electrical connection (temperature sensor) for temperature display |
| 16 = Oil dipstick | |
| 17 = Solenoid valve for retarder tank | |



- 35 = Compressed air hose for retarder control
- 36 = Connection for retarder control pressure switch
- 37 = Connection for retarder control and brake light pressure switch
- 38 = Accelerator interlock cylinder with compressed air connection
- 39 = Pedal brake valve for retarder or service brake
- 40 = Retarder valve
- 41 = Kick-down switch
- 42 = Selector lever valve for retarder operation
- 43 = Throttle valve
- 44 = Load sensor for electric pressure modulation

TROUBLESHOOTING GUIDE

- 1 Engine cannot be started
- 2 Lockup clutch does not engage
- 3 Lockup clutch does not disengage
- 4 Transmission does not upshift
- 5 Transmission does not downshift
- 6 Reverse gear does not engage
- 7 Incorrect shift points
- 8 Shift points too hard
- 9 Engine races during shifting
- 10 Retarder not functioning
- 11 Retarder does not cut out
- 12 Excessive retarder effect
- 13 Retarder response time too long (responds too slowly)
- 14 Oil temperature too high
- 15 Oil loss, excessive oil consumption
- 16 Not enough traction
- 17 Transmission does not engage
- 18 Transmission engaged when shift selector is in neutral

NOTE:

The items in this troubleshooting guide are arranged in sequence, with the easiest checks and remedies listed first. Less frequent faults and time-consuming remedies are listed last.



TROUBLESHOOTING

	Fault	Potential Cause	Check Note	Remedy
1	Engine cannot be started	- Transmission shift selector not in neutral position	_____	Move shift selector to neutral
		- Transmission electrical system not correctly connected up	Check plugs at shift selector and control box	Position correctly
		- Fuse of transmission electrical system blown	_____	Renew fuse
		- Starter lockout defective	_____	Renew relay
		- Control box defective	Test output signal with PR-61 tester	Renew control unit
2	Lockup clutch does not engage	- Inductive sensor (turbine) defective	Check internal resistance	Renew inductive sensor
		- Inductive (turbine) sensor incorrectly set	Check clearance	Set correct clearance
		- Converter defective	_____	Renew converter
		- Hydraulics defective		Renew complete hydraulic system
		- Control box defective	Test signal output with PR-61 tester	Renew control box
3	Lockup clutch does not disengage	- Incorrect inductive (turbine) sensor setting	Check setting	Set correct clearance
		- Inductive sensor defective	Check internal resistance	Renew inductive sensor
		- Control box defective	Test output signal with PR-61 tester	Renew control box



TROUBLESHOOTING

	Fault	Potential Cause	Check Note	Remedy
3		- Hydraulics defective	_____	Renew complete control box
4	Transmission does not upshift	- Converter defective	_____	Renew converter
		- Inductive sensor on output incorrectly set	Check setting	Set correct clearance
		- Inductive sensor or connection defective	Check internal resistance	Renew inductive sensor or renew/repair wiring
		- Solenoid valve defective	Test internal resistance with test cable	Renew solenoid valve
		- Hydraulics defective	_____	Renew complete control box
		- Control box defective	Simulate upshift with PR-61 tester	Renew control box
5	Transmission does not downshift	- Incorrect inductive sensor setting on output	Check setting	Set correct clearance
		- Inductive sensor defective	Test internal resistance with test cable	Renew inductive sensor and readjust
		- Control box defective	Simulate downshift with PR-61 tester	Renew control box
6	Reverse gear does not engage	- Solenoid valve defective	Test with test cable	Renew solenoid valve
		- Hydraulics defective	_____	Renew valve body



TROUBLESHOOTING

	Fault	Potential Cause	Check Note	Remedy
6		- Control box defective	Test clutch indicator with PR-61 tester	Renew control box
7	Incorrect shift points	- Incorrect load sensor adjustment	Check adjustment	Adjust linkage
		- Load sensor defective	Test voltage with PR-61 tester	Renew load sensor
		- Inductive sensor incorrectly set on output	Check setting	Set correct clearance
		- Control box defective	Test with PR-61 tester	Renew control box
8	Hard shifts	- Incorrect load sensor adjustment	Check adjustment	Renew linkage
		- Hydraulics defective	_____	Renew complete control box
9	Engine races during shifting	- Oil level too low	Check oil level	Adjust oil level
		- Solenoid valve defective	_____	Renew complete solenoid valve
		- Oil filter blocked	_____	Renew oil filter, change oil, consult ZF
		- Main pressure too low	Measure main pressure at measuring point 1	Consult ZF





TROUBLESHOOTING

	Fault	Potential Cause	Check Note	Remedy
10	Retarder not functioning	- Oil level too low	Check oil level	Correct oil level
- Retarder switched off		_____	Switch on retarder	
- No voltage in retarder solenoid valve		Test electrical system with PR-61 tester	Correct electrical fault	
- Loose electrical connections		_____	Check and tighten plugs	
- Brake pressure switch defective		Test with PR-61 tester or voltmeter	Renew switch	
- No air at retarder solenoid valve		Check air pressure at solenoid valve *	Check compressed air supply	
- Retarder solenoid valve defective		Unscrew solenoid valve, check air passage	Renew retarder solenoid valve	
- Retarder control valve not operating		Check pressure R3 at measuring point 5	Consult ZF	
- Control box defective		Test with PR-61 tester	Renew control box	
- Transmission damaged		_____	Renew transmission	

* WARNING - accident risk!

TROUBLESHOOTING

	Fault	Potential Cause	Check Note	Remedy
11	Retarder does not cut out	- Retarder solenoid valve defective	Unscrew solenoid valve, check air passage	Renew solenoid valve
		- Brake pressure switch defective	Test with PR-61 tester or voltmeter	Renew switch
		- Control box defective	Test retarder output with PR-61 tester	Renew control box
12	Retarder effort too low	- Oil level too low	Check oil level	Correct oil level
		- Air pressure at retarder control valve too low	Check air pressure at control valve *	_____
		- Retarder control valve defective	Check pressure R3 at measuring point 5	Consult ZF
13	Retarder response time too long (responds too slowly)	- Solenoid valve on accumulator defective	Unscrew solenoid valve, check air passage	Renew solenoid valve
		- No voltage at accumulator solenoid valve	Test electrical system with PR-61 tester	Renew solenoid valve
		- No air at accumulator solenoid valve	Unscrew compressed air supply to solenoid valve	Check compressed air supply
14	Oil temperature too high	- Loose electrical connections	_____	Check and tighten
		- Temperature sensor or temperature gauge defective	_____	Renew temperature sensor or temperature gauge

* WARNING - accident risk!



57

TROUBLESHOOTING				
	Fault	Potential Cause	Check Note	Remedy
		- Oil level too high or too low	Check oil level	Correct oil level
		- Lockup clutch not engaging	See 2	_____
		- Coolant circuit faulty	Check coolant circuit, check radiator	Top up coolant, clean radiator
		- Retarder does not cut out	See 11	_____
		- Transmission damaged	_____	Consult ZF
15	Oil loss, excessive oil consumption	- Incorrect oil level	Check oil level	Correct oil level
		- Oil drain plug leaking	_____	Insert sealing ring
		- Accumulator leaking	_____	Renew accumulator
16	Not enough traction	- Engine not reaching full speed or power	Check governed speed and stall speed	Check accelerator and governed-pressure linkage
		- Converter damaged	Check oil level and stall speed	Correct oil level, consult ZF
17	Transmission does not engage	- Control box in safety lockup mode	Turn off ignition, restart engine	Turn off ignition, restart engine
		- Oil level too low	Check oil level	Correct oil level
		- Control box de-energized, loose electrical connection, fuse blown	Test electrical system with PR-61 tester	Reconnect, renew control box
		- Transmission shift selector defective	Test with PR-61 tester	Renew shift selector
		- Control box defective	Test clutch indicator with PR-61 tester	Renew control box
		- Solenoid valve defective	Check solenoid valve function and internal resistance with test cable	Renew solenoid valve



TROUBLESHOOTING

	Fault	Potential Cause	Check Note	Remedy
		- Oil filter blocked	Check filter consult ZF	Renew oil filter,
		- Transmission locked	Check oil filter, check oil level	Consult ZF
18	Transmission engaged when shift selector is in neutral	- Shift selector defective	Test shift selector with PR-61 tester	Renew shift selector
		- Control box defective	Test clutch indicator with PR-61 tester	Renew control box
		- Clutch seized	Check oil level Check oil filter	Consult ZF





Solenoid Valves, Switches and Inductive Sensors

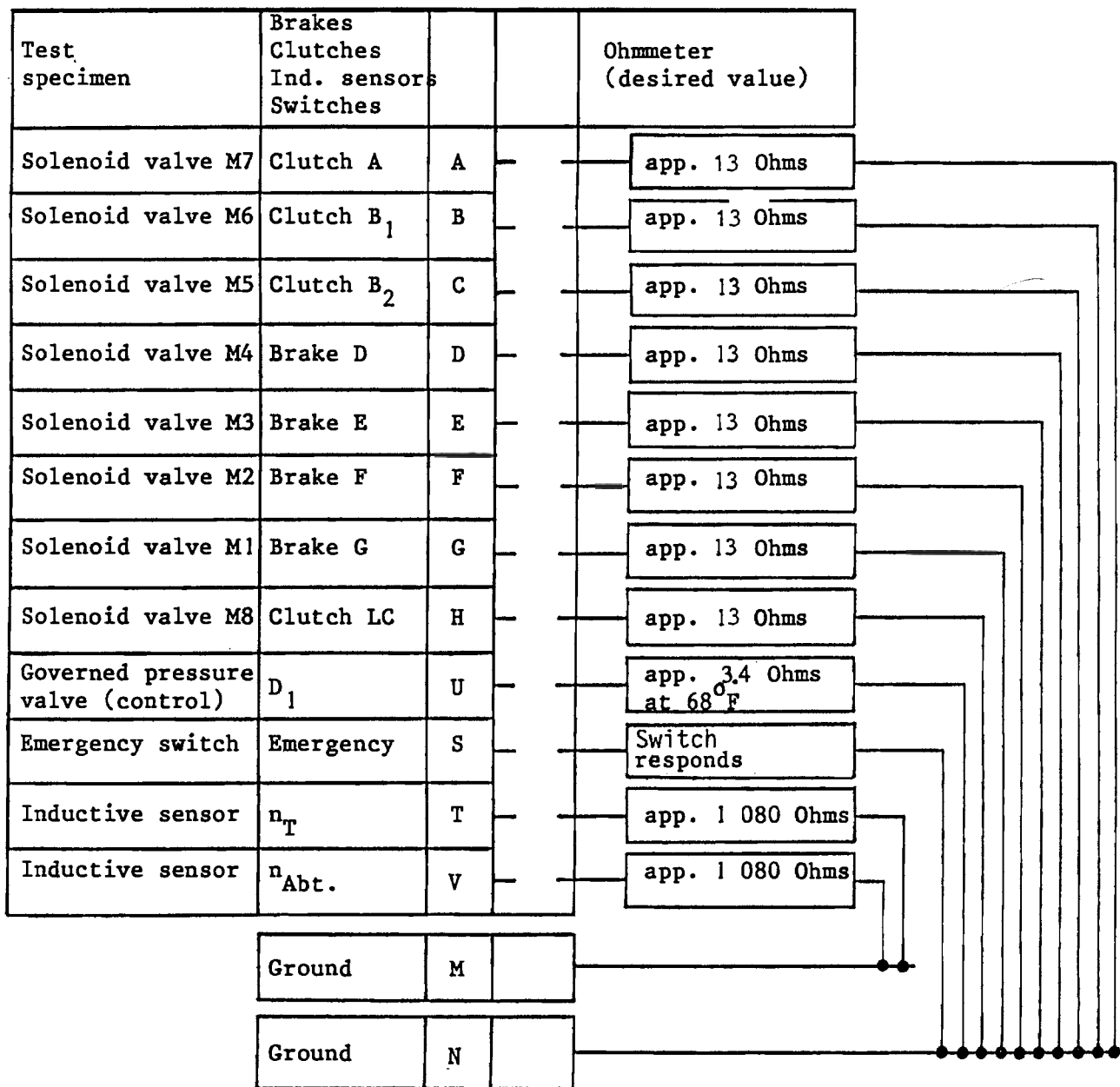
Testing instructions for test cable IPO1 137 002

a) Insert Cannon plug of test cable into Cannon socket on transmission.

WARNING: The test cable must only be used when the vehicle is stationary and the engine turned off

b) Resistance measurements: see following scheme for measuring resistances of solenoid valve coils and inductive sensor.

CAUTION: Do not apply voltage to the emergency switch (yellow bushings) and inductive sensor (green bushings) as this will cause the switch or inductive sensor to short-circuit and fail, necessitating the removal of the transmission.



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CIRCUIT DIAGRAM

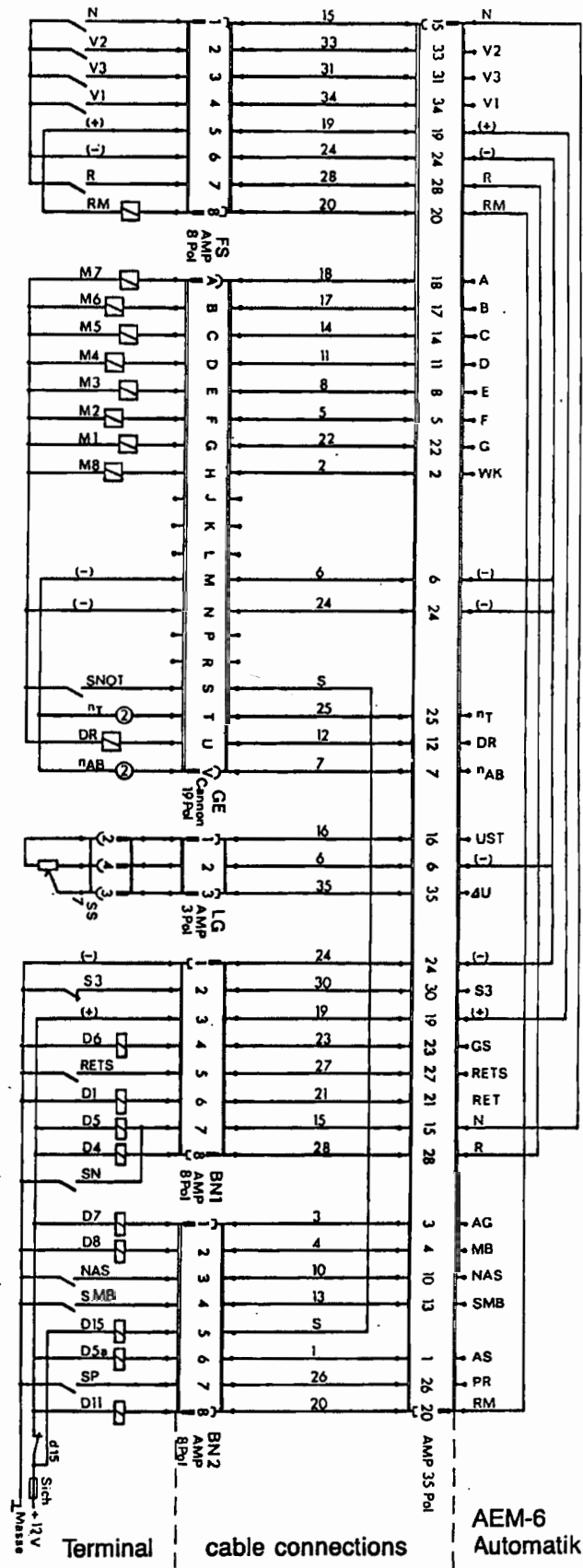
CABLE COLOR CODE

ZCH/ABBR.	FARBE	COLOR
WS	WEISS	WHITE
BR	BRAUN	BROWN
GN	GRÜN	GREEN
GE	GELB	YELLOW
GR	GRAU	GRAY
RS	ROSA	PINK
BL	BLAU	BLUE
RT	ROT	RED
SW	SCHWARZ	BLACK
VI	VIOLETT	PURPLE

Bei Doppelfarben 1. Farbe A Hauptfarbengruppe
 Double colors: 1st color + main (group) color

- Selector switch
- N neutral
- V2 preselector 2
- V3 preselector 3
- V1 preselector 1
- (+) power supply
- (-) ground
- R reverse
- RM interlocking solenoid
- Transmission
- M7 shift sol old 7 clutch A
- M6 shift solenoid 6 clutch B
- M5 shift solenoid 5 clutch B2/C
- M4 shift solenoid 4 clutch D
- M3 shift solenoid 3 clutch E
- M2 shift solenoid 2 clutch F
- M1 shift solenoid 1 clutch G
- M8 shift solenoid lock up
- (-)
- SNOT emergency switch
- n_T inductive sensor, turbine
- DR pressure regulator
- n_{Abt.} inductive sensor, output
- Load sensor
- UST stabilized voltage
- Δ U controlled voltage
- Bordnetz
- (-) ground
- S3 kick-down switch
- (+) power supply
- D5 speed signal
- RETS retarder signal
- D1 retarder ready
- D5 starter lock
- D4 reversing lights
- SN neutral, external
- D7 accelerator interlock
- D8 engine brake ready
- NAS power take-off signal
- SMB engine brake switch
- D15 emergency switch
- D5a starter lock, external
- SP programm changeover
- D11 neutral release

Legend



AEM-6 Automatik

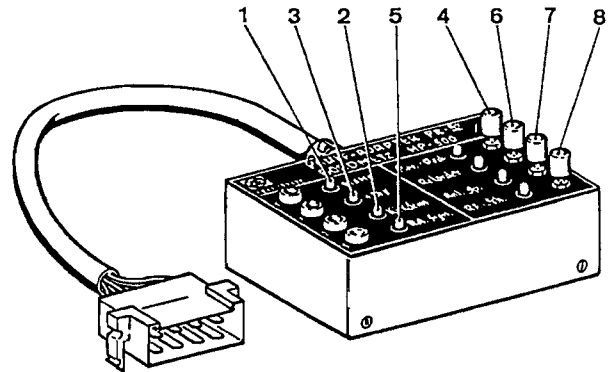
Fig. 3

Test Instruction for Test Adapter (PR-52) 1P01 137 179

Connect test adapter to vehicle power isolating point (vehicle power plug) and switch on ignition.

Test Requirements:

12 V vehicle power voltage
storage air to 7.35 bar



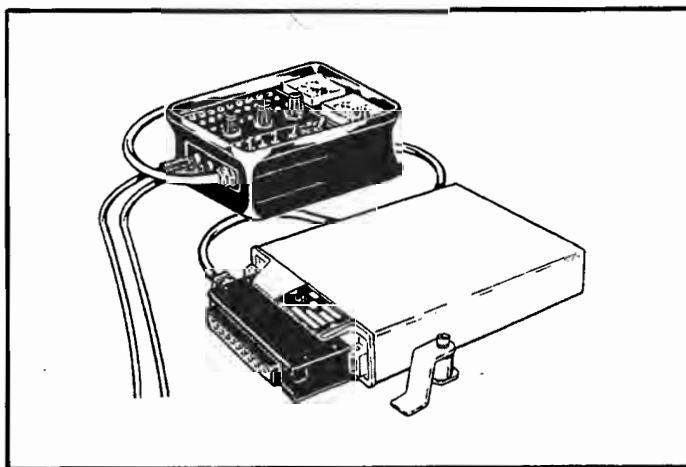
Test:

- 1 = ground: green lamp lights up if polarity correct (-)
- 3 = + 12 V: red lamp lights up if polarity correct (+)
- 2 = yellow lamp: lights up when "kickdown" is operated
- 5 = yellow lamp: lamp lights up when handlever valve or pedal operated
- 4 = green lamp: version with retarder air pressure drop.
When button 4 is operated (lamp lights up) the related solenoid valve V4 is actuated by relay D6.
- 6 = red lamp: when button 6 is operated (lamp lights up) the related solenoid valves V1 and V2 are actuated by relay D1.
- 7 = yellow lamp: when button 7 is operated (lamp lights up) relay D5 is actuated and the starting lock cancelled. It is thus possible to start the engine.
- 8 = yellow lamp: when button 8 is operated (lamp lights up) relay D4 is actuated and the reversing lamp comes on.

ZF-ECOMAT

1. INSTRUCTIONS FOR ELECTRONIC TEST UNIT

MODEL PR-61 (1P01 137 304)



ZAHNRADFABRIK FRIEDRICHSHAFEN AG

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Kundendienst Werk II: Telefon (0 75 41) 77-0, Telex: 7 34 207-21, 22, 25 zfd



	Page	
1.1	General Instructions	23
1.2	Basic Setting	23
1.3	Clutch and Brake Combinations	25
1.4	Tester Hook-Up	26
1.5	General Notes	28
2	Test Procedures	
2.1	Shift Selector	29
2.2	Neutral Starter Lock	30
2.3	Reverse Speed and Accelerator Interlock	31
2.4	Shifting through Forward Speed Range	32
2.5	Output for Modulating Pressure	33
2.6	Lockup Clutch "H" - Engine Speed Dependent	34
2.7	Lockup Clutch "H" - Gear Dependent	35
2.8	Overrun Up and Down Shifts	36
2.9	Up and Down Shifts under Load	37
2.10	Retarder Cutout during Acceleration	38
2.11	Up-Shift Lock for Power Take-Off	39
2.12	Emergency Shifting (Program Dependent)	40
2.13	Load Sensor	41
2.14	Speed Output (Detent Solenoid Output)	42
2.15	Kick-Down Switch	40



1.1 Instructions for testing control box with PR-61 tester

General Instructions:

These instructions cover all functional tests of the electronic shift control unit, i.e. transmission control box, with the PR-61 tester.

If one or more of the items in the result column produce incorrect results, re-check the initial setting and repeat the test.

If the results remain incorrect after the initial setting has been double-checked and the test procedure carefully repeated, the electronic control box is probably defective. Renew the control box and repeat the tests.

NOTE: when testing with the engine running, set operating mode switch to "Travel".

When testing with the engine still, set operating mode switch to "Test".

NOTE: only the indicator lamp which is required for each individual test is shown. All other lamps lighting up can therefore be disregarded. It is essential to follow the sequence of the individual test stages.

Symbols:

Indicator lamp remains on throughout test procedure. ●

Indicator lamp lights up periodically during test procedure. ◐

1.2 Basic Setting

Set rotary knob "LAST/LOAD"
to position "KD"

Set rotary knob "VORWAHL/PRESELECTOR"
to position "D"

Turn turbine and output rotary knobs counterclockwise as far as possible

Set operating mode switch to "TEST"

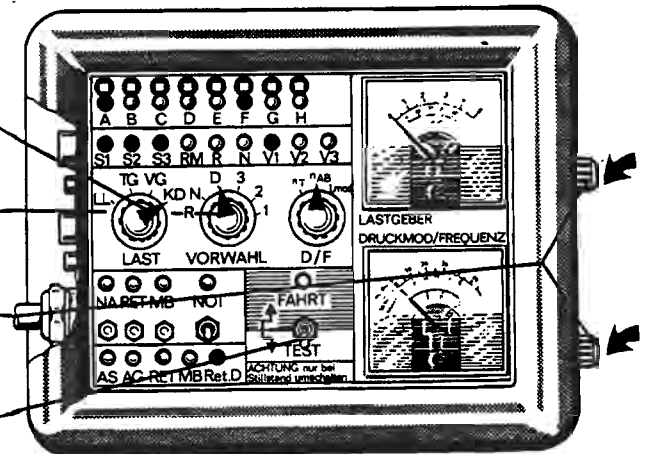


Fig. 4

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1.2.1 PR-61 Tester - Description

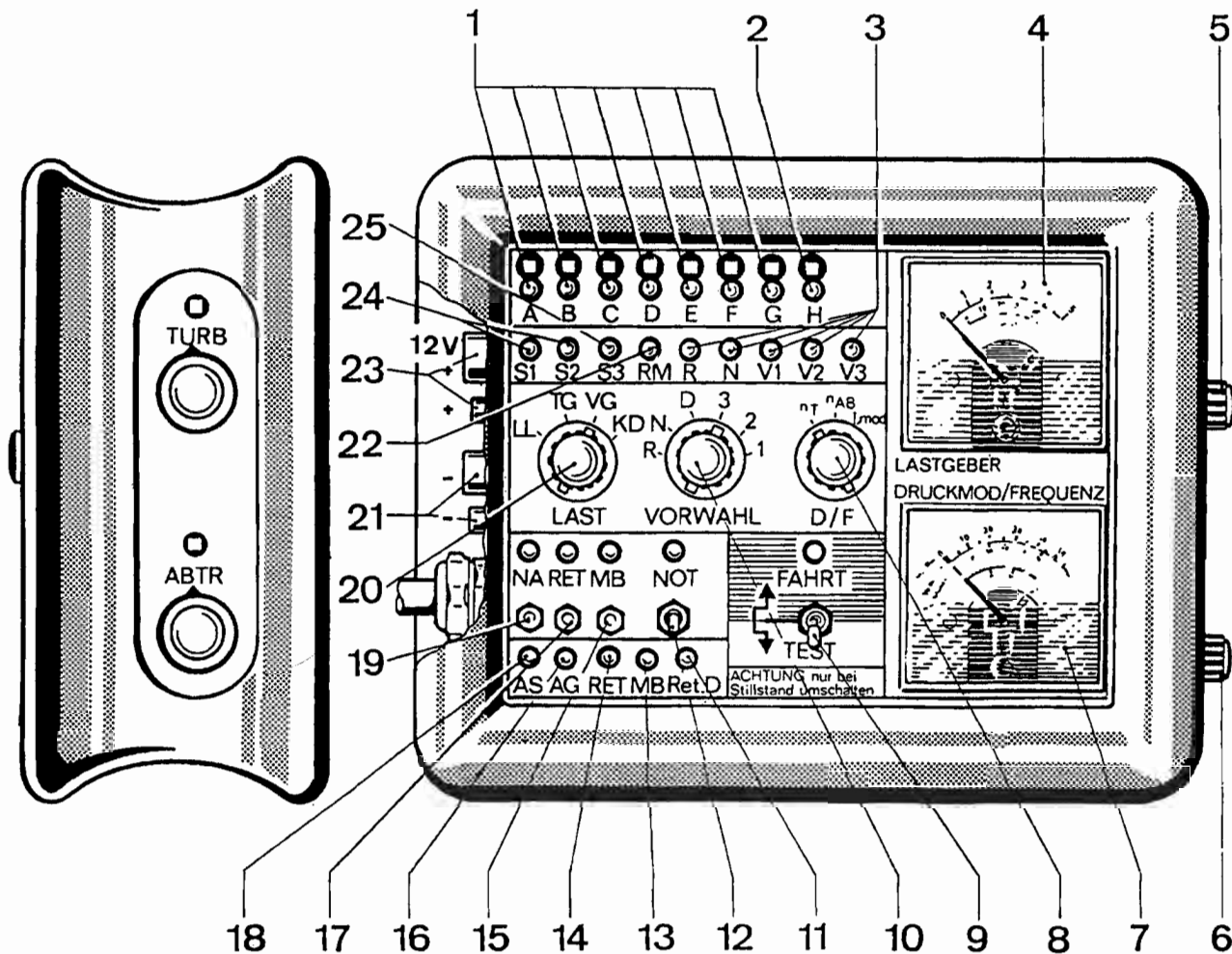


Fig. 5

- | | | | |
|----|--|----|--------------------------------------|
| 1 | Clutch indicator with bushings | 11 | Retarder reduction indicator lamp |
| 2 | Lockup clutch indicator with bushings | 12 | Emergency switch * |
| 3 | Shift selector indicator lamps | 13 | Indicator lamp, engine brake * |
| 4 | Load sensor indicator | 14 | Indicator lamp, retarder |
| 5 | Turbine frequency generator rotary knob | 15 | Engine brake push switch * |
| 6 | Output frequency generator rotary knob | 16 | Accelerator interlock indicator lamp |
| 7 | Lower indicator: output speed, turbine speed and current indicator | 17 | Retarder push switch |
| 8 | Function selector switch for lower meter | 18 | Start interlock indicator lamp |
| 9 | Operating mode switch | 19 | Power take-off push button |
| 10 | Range preselector rotary switch | 20 | Load condition rotary knob |
| | | 21 | Ground terminal * |
| | | 22 | Detent solenoid indicator |
| | | 23 | +12/+24 V terminals * |
| | | 24 | Load condition indicator lamps |
| | | 25 | Kick-down indicator |
| | | * | Not in use, special application |



1.3 Clutch Combinations for HP 500/HP 590/HP 600

No. of gears	Transmission Type and Parts List			Ratio	Design
	HP 500	HP 590	HP 600		
4-speed	4139 002 ...	4139 052 ...	4139 062 ...	2.81 - 1.0	1
4-speed	4139 006 ...	4139 056 ...	4139 066 ...	3.43 - 1.0	1
5-speed	4139 001 ...	4139 051 ...	4139 061 ...	2.81 - 0.8	1
5-speed	4139 003 ...	4139 053 ...	4139 063 ...	3.43 - 0.83	1
5-speed	4139 008 ...		4139 068 ...	5.6 - 1.0	3
5-speed	4139 009 ...		4139 069 ...	4.31 - 1.0	2
6-speed	4139 004 ...		4139 064 ...	3.43 - 0.59	1
6-speed	4139 005 ...		4139 065 ...	5.6 - 0.83	3
6-speed	4139 007 ...		4139 067 ...	4.31 - 0.8	2

Design 1: "short" version
 Designs 2 and 3: "long" versions

	A	B1	B2	D	E	F		A	B	C	D	E	F	
4-SPEED, BUS							4139 002	5-SPEED, BUS						4139 001
Reverse			•			•	4139 006	Reverse			•		•	4139 003
Neutral							4139 052	Neutral						4139 051
1st gear	•					•	4139 056	1st gear	•				•	4139 053
2nd gear	•				•		4139 062	2nd gear	•			•		4139 061
3rd gear	•			•			4139 066	3rd gear	•		•			4139 063
4th gear	•	•						4th gear	•	•				
								5th gear		•	•			
5-SPEED, Truck							4139 003	6-SPEED, Truck						4139 004
Reverse			•			•	4139 053	Reverse			•		•	4139 064
Neutral							4139 063	Neutral						
1st gear	•					•		1st gear	•				•	
2nd gear	•				•			2nd gear	•			•		
3rd gear	•			•				3rd gear	•		•			
4th gear	•	•						4th gear	•	•				
5th gear		•	•					5th gear		•	•			
								6th gear		•		•		
5-SPEED, Truck							4139 008	6-SPEED, Truck						4139 005
Reverse			•			•	4139 009	Reverse			•		•	4139 007
Neutral							4139 068	Neutral						4139 065
1st gear	•					•	4139 069	1st gear	•				•	4139 067
2nd gear	•				•			2nd gear	•			•		
3rd gear	•			•				3rd gear	•			•		
4th gear	•			•				4th gear	•		•			
5th gear	•	•						5th gear	•	•				
								6th gear		•	•			

Fig. 6 * Without "C" clutch. The "B" clutch consists of
 B1 in inner piston surface and
 B2 in outer piston surface
 (indicated by lamp "C" on tester)

--	--	--



1.4 Hook-Up Instructions - In-Vehicle Tests

- 1.4.1 The vehicle must have normal operating air pressure.
- 1.4.2 The engine must be at a standstill and the ignition (power supply) turned off.
- 1.4.3 Separate main transmission wiring harness from electronic control box. See Fig. 7.
- 1.4.4 Plug PR-61 tester into the electronic control unit. See Fig. 7.
- 1.4.5 Plug main transmission wiring harness to back of terminal for PR-61 tester. See Fig. 7. In other words, the 2-sided connector for the PR-61 tester is located between the electronic control box and the main transmission wiring harness, where it can intercept all signals passing between the transmission and control box.

CAUTION: Do not plug any wires into the tester at this stage.

Hook-up of PR-61 tester to vehicle

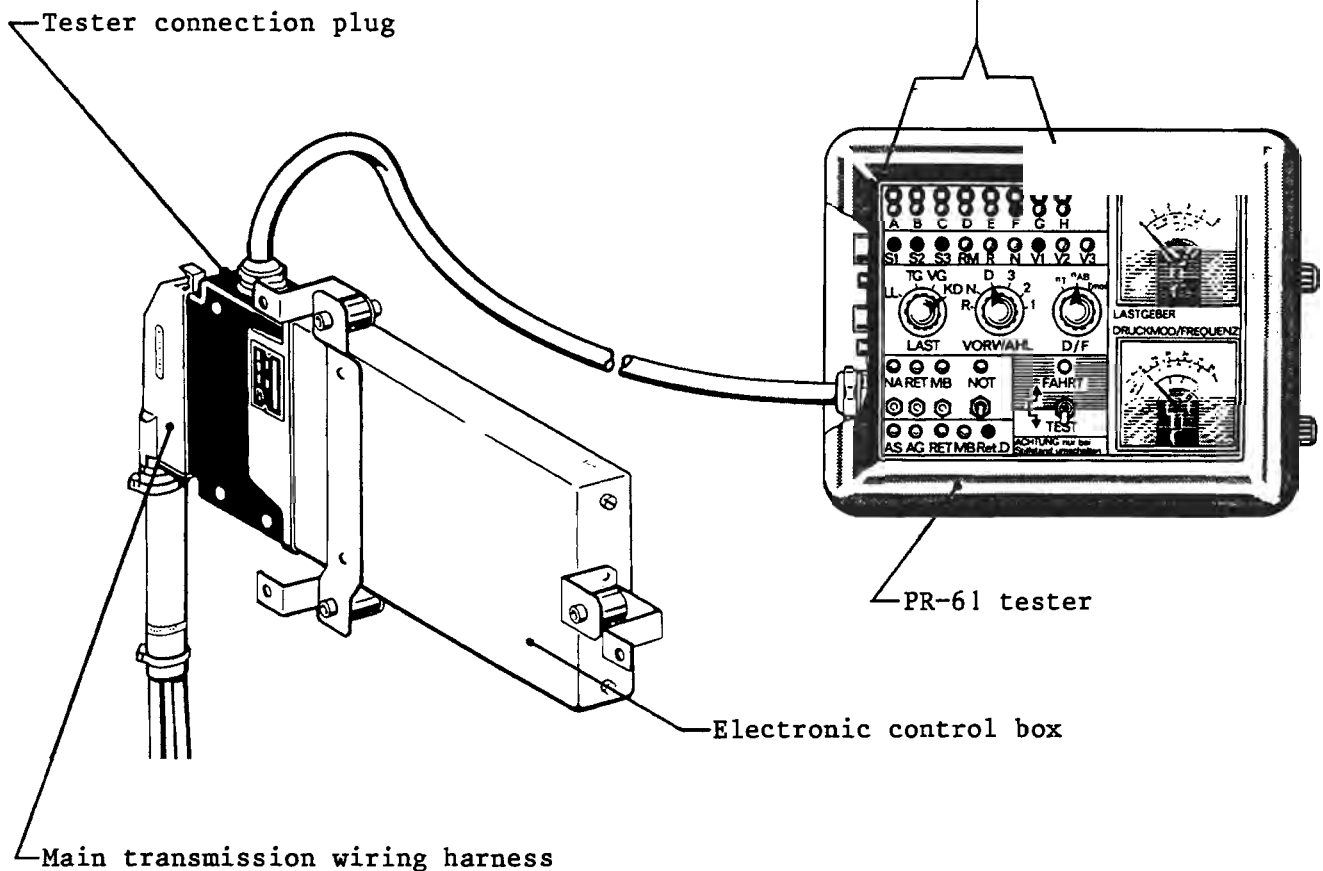


Fig. 7



1.4.6 Switches and knobs on PR-61 unit in basic setting.
See Fig. 4

CAUTION: Ensure that there is no battery charger connected up to the vehicle.

1.4.7 Turn on vehicle's ignition (power from battery), but DO NOT START THE ENGINE!

CAUTION: Only conduct tests when the vehicle is stationary, with the engine stopped and ignition on.

1.4.8 Set transmission shift selector (No. 10 on Fig. 5) to "N" and back to "D".

1.4.9 Push transmission shift selector "D" (No. 10 on Fig. 2)

NOTE: Unless otherwise stated, the vehicle's transmission shift selector must remain at "D" during this test procedure.

NOTE: The accelerator interlock and neutral-position interlock on the transmission prevent correct usage of the PR-61 tester if the vehicle emergency brake is on.

WARNING: Block vehicle wheels to prevent the vehicle from rolling away.

1.4.10 Release vehicle emergency brake to test the transmission with the PR-61 unit, first making sure that the vehicle wheels are blocked to prevent it from rolling away.

WARNING: Even apparently level workshop floors are slightly sloped for drainage purposes. Always block the vehicle's wheels during testing work, so that the vehicle cannot roll in either direction.





1.5 General Instructions

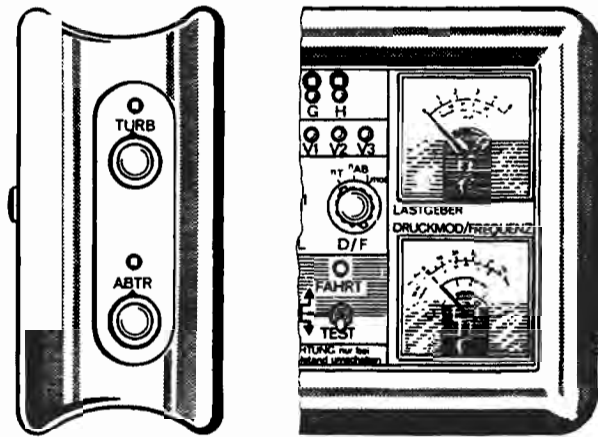


Fig. 8

Turn knob "ABTR" slowly when testing, otherwise control box will not shift.

Fig. 8

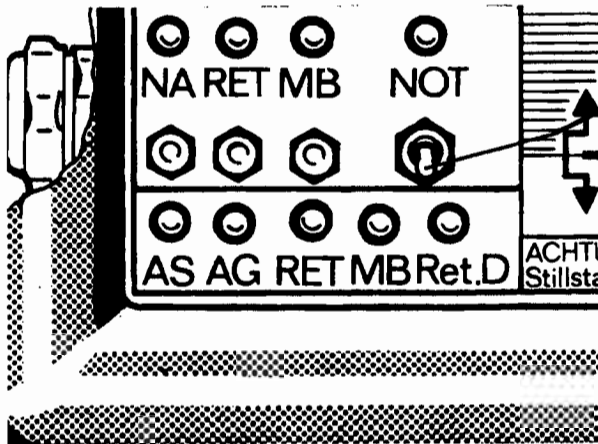


Fig. 9

Emergency switch (NOT) must point downwards and the "EMERGENCY" (NOT) lamp must be off during all testing procedures.

Fig. 9

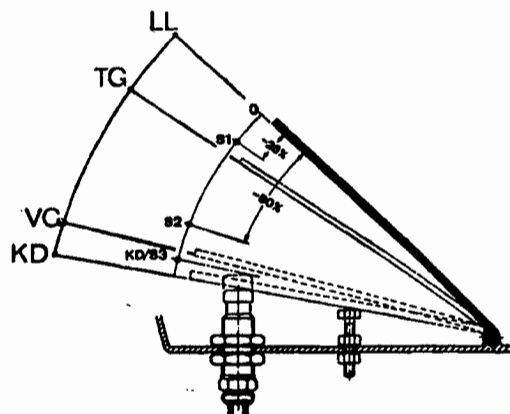


Fig. 10

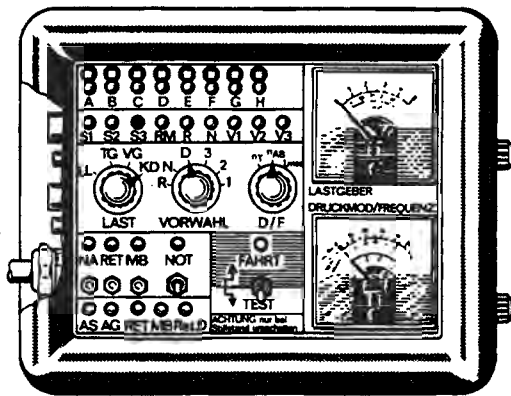
Fig. 10 represents the accelerator pedal in idle position and all other pedal positions.

- LL = idle
- TG = part throttle
- VG = full throttle
- KD = kick-down

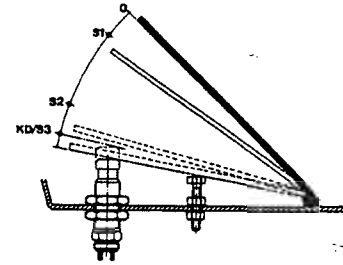
Fig. 10



2. Test: 2.1 Shift selector



Accelerator position: LL



Note:

Setting:

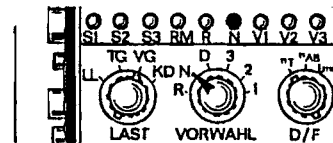
Result:

(1) Basic setting of PR-61 tester.

(2) Select "N" at shift selector.
Select "N" at PR-61 tester.



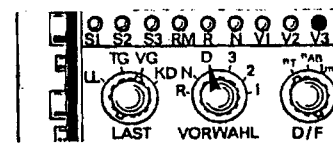
Indicator lamp "N" comes on.



(3) Select "D" at shift selector.
Select "D" at PR-61 tester.



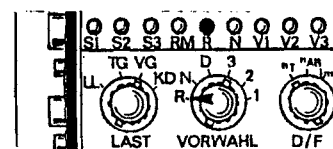
Indicator lamp "V3" comes on.



(4) Select "R" at shift selector.
Select "R" at PR-61 tester.



Indicator lamp "R" comes on.

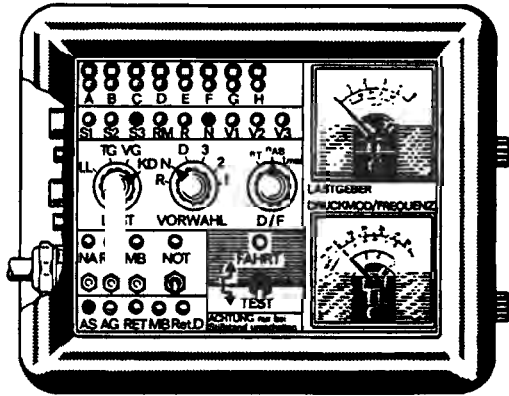


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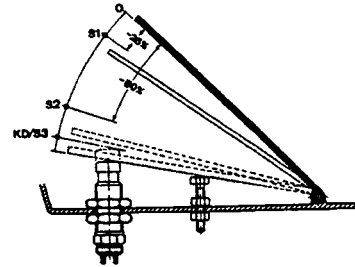
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Test: 2.2 Start interlock in neutral position



Accelerator position: LL



Note:

Setting:

Result:

(1) Basic position of PR-61 tester.

(2) Select "N" at rotary pre-selector knob.

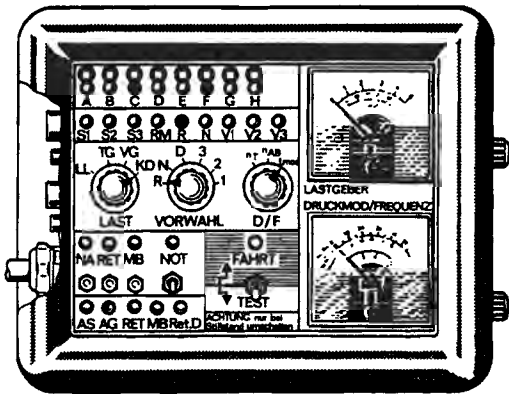
Indicator lamp "AS" comes on.

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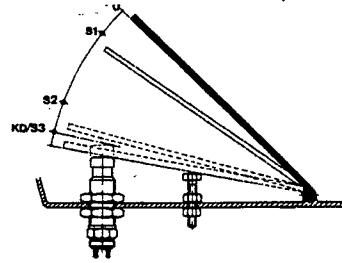
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Test: 2.3 Reverse and accelerator interlock



Accelerator position: LL



Note: Set vehicle's shift selector button to "R" for reverse.

Setting:	Result:
(1) Basic setting of PR-61 tester.	_____
(2) Rotary function knob "D/F" to position "I, mod". 	_____
(3) Rotary preselector knob to position "R".  Press vehicle's shift selector to "R".	<p>When "R" is selected, lamp "AG" comes on briefly and then goes off again.</p> <p> : Indicator lamps "F" or "C" come on after a delay.</p> <p>Current is indicated in the control solenoid for app. 1.5 seconds.</p>
(4) NOTE: after completing testing work, set the vehicle's shift selector back to "D" (drive).	_____

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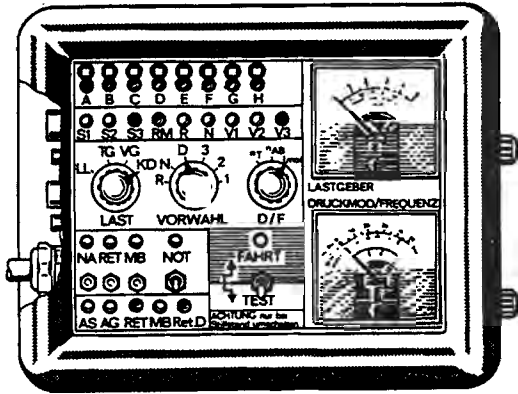
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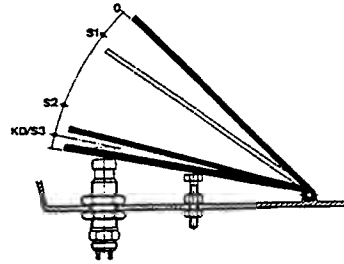
<p>Test: 2.4 Shifting through forward speed range</p>	
	<p>Accelerator position: LL TG VG KD</p>
<p>Note:</p> <p>Reading on upper meter is: 0.1 - 0.3 V at "idle" (LL) accelerator pedal position 1.5 V at "part throttle" (TG) accelerator pedal position 1.8 - 2.1 V at "full throttle" (VG) accelerator pedal position 1.8 - 2.1 V at "kick-down" (KD) accelerator pedal position</p>	
<p>Setting:</p>	<p>Result:</p>
<p>(1) Basic setting of PR-61 tester.</p>	<hr/>
<p>(2)</p> <p>Function selector switch "D/F" in position "n". Turn "ABTRIEB" rotary knob slowly clockwise.</p>	<p>When the button is turned, clutch combinations A and F, A and E, A and D and AB light up in sequence on the clutch indicator lamps. The rpm at upshift point can be read off at the lower display unit. Note: indicator lamp "RET. D" lights up in 1st and 2nd gear. See clutch combinations on page 23.</p>
<p>(3)</p> <p>Turn frequency generator knob "ABTR" slowly counter-clockwise.</p>	<p>While the knob is being turned, indicator lamps for the various clutch combinations in 4th, 3rd, 2nd and 1st gear light up in sequence. The downshift point RPMs can be read off at the lower meter.</p>
<p>(4)</p> <p>Repeat test in accelerator pedal positions LL, TG, VG, KD.</p>	<hr/>



Test: 2.5 Output for modulating pressure



Accelerator position: LL
VG
KD



Note:

Reading on upper meter is:
 0.1 - 0.3 V at "idle" (LL) accelerator pedal position
 1.8 - 2.1 V at "full throttle" (VG) accelerator pedal position
 1.8 - 2.1 V at "kick-down" (KD) accelerator pedal position

Setting:

Result:

(1) Basic setting

(2) Set function selector switch "D/F" to position "I, mod."



When frequency generator "ABTR" is turned clockwise and counterclockwise, the current passage through the transmission pressure modulation valve appears on the lower display unit.



(3) Turn frequency generator knob "ABTR" slowly clockwise.

(4) Turn frequency generator knob "ABTR" slowly counterclockwise.

Note: reading is determined by accelerator pedal position.

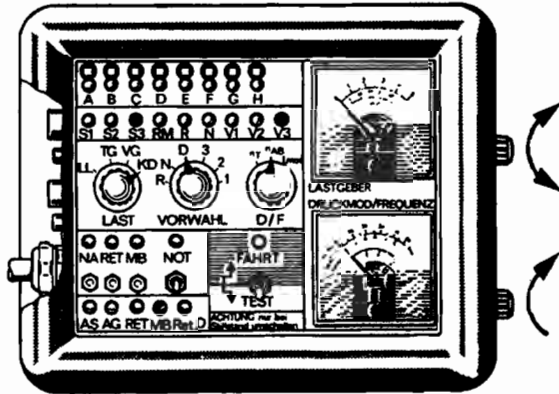
(5) Repeat test in other accelerator pedal positions: LL, VG, KD.

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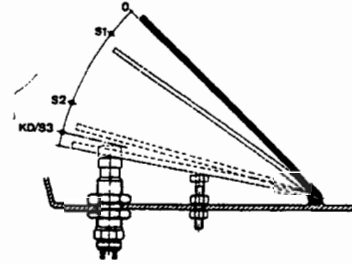
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Test: 2.6 Lockup clutch "H", dependent on engine rpm



Accelerator position: LL



Note:

Setting:

Result:

(1) Basic setting

(2) Function selector switch "D/F" to position "n_{AB}".



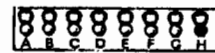
(3) Turn frequency generator knob "ABTR" clockwise until lower meter reading is approx. 100 Hz.



(4) Turn frequency generator knob "TURB" clockwise.



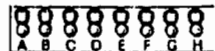
Indicator lamp "H" comes on.



(5) Turn frequency generator knob "TURB" counter-clockwise.



Indicator lamp "H" comes on.

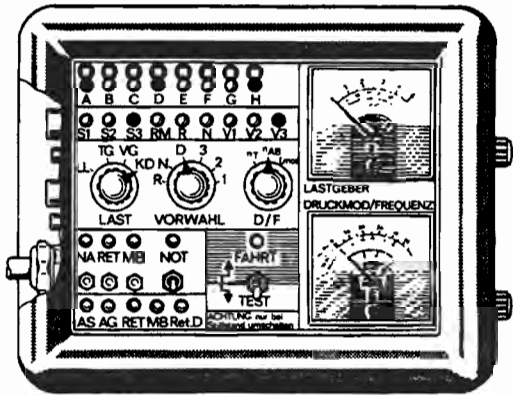


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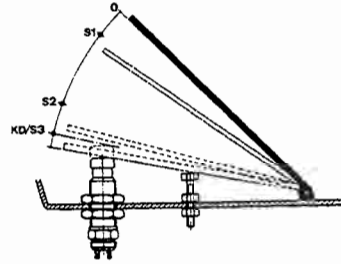
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Test: 2.7 Lockup clutch "H", dependent on gear



Accelerator position: LL



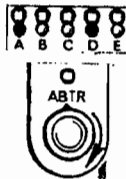
Note:

Setting:

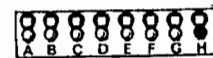
Result:

(1) Basic setting

(2) Turn rotary knob "ABTR" clockwise until indicator lamps "A" and "D" light up.



Indicator lamp "H" lights up.

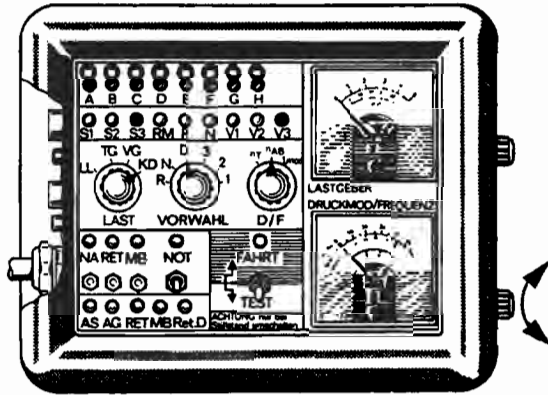


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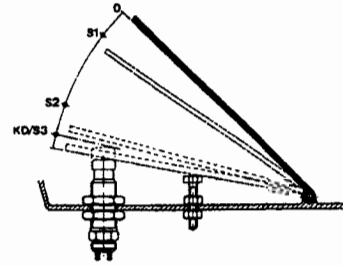
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Test: 2.8 Overrun up and downshifts



Accelerator position: LL



Note:

Setting:

Result:

(1) Basic setting

(2) Turn rotary knob "ABTR" slowly clockwise.



The clutch indicator lamps come on in sequence with a delay of app. 1 second during upshifting.

(3) Turn rotary knob "ABTR" slowly counterclockwise.



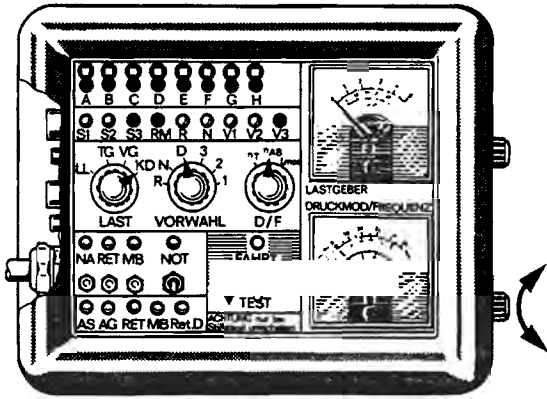
Clutch indicator lamps come on correspondingly during downshifting, without time delay.

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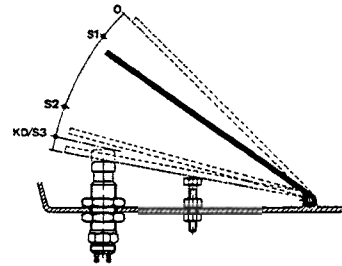
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Test: 2.9 Up and downshifts under load



Accelerator position: TG



Note:

Setting:

Result:

(1) Basic setting

(2) Accelerator pedal in part throttle position (TG).

(3) Turn rotary knob "ABTR" slowly to right.



Clutch indicator lamps come on in sequence without time delay.

(4) Turn rotary knob "ABTR" slowly to left.



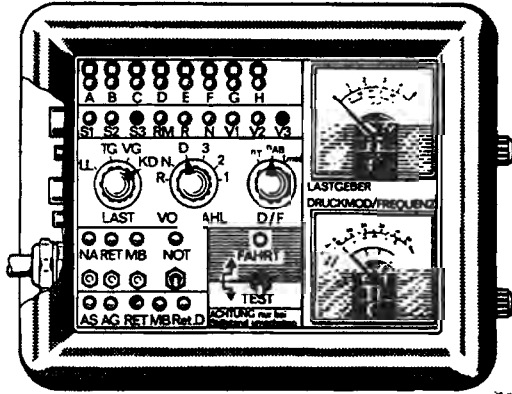
Clutch indicator lamps come on in sequence with brief time delay.

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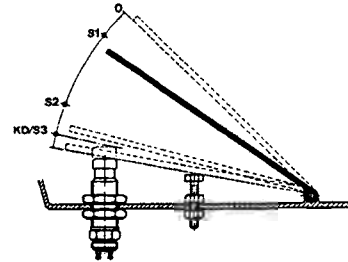
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Test: 2.10 Retarder disengaged during acceleration



Accelerator position: TG



Note:

Setting:

Result:

(1) Basic setting

(2) Push brake pedal and hold.

(3) Push accelerator pedal to part throttle position (TG).

Lower indicator lamp "RET" goes out.

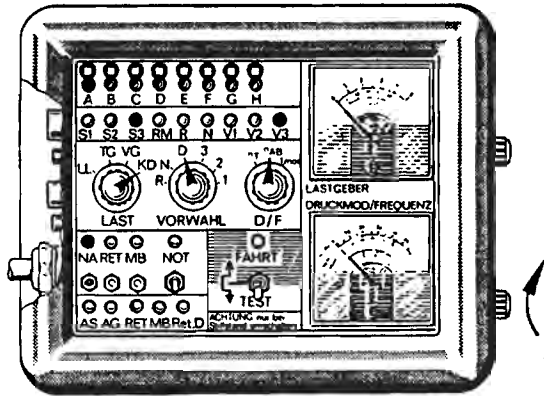
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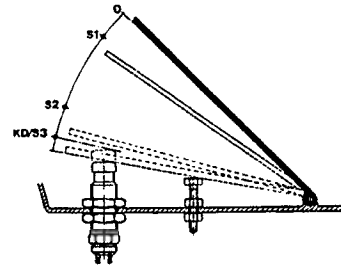
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Test: 2.11 Up-Shift Lock for Power Take-Off





Accelerator position: LL



Note:

Up-shift lock is program-dependent.

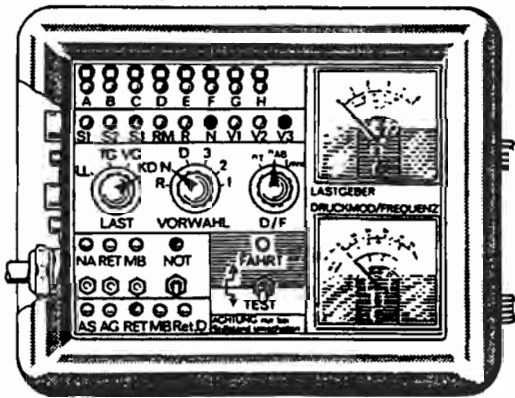
Setting:	Result:
(1) Basic setting	_____
(2) Push button "NA", simultaneously turning rotary knob "ABTR" clockwise. 	The transmission must not shift up.
(3) Release "NA" pushbutton. 	Transmission shifts up to next speed.

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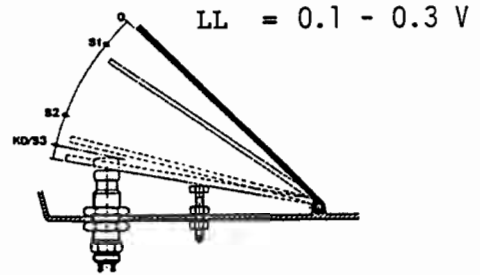
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Test: 2.12 Emergency Shifting (Program Dependent)



Accelerator position:



Note:

Setting:

Result:

(1) Basic setting

(2) Set rotary knob "VORWAHL" to "N".



(3) Operate emergency shifting on vehicle

Note:

When removed from the vehicle, press "NOT" tumbler switch to test.



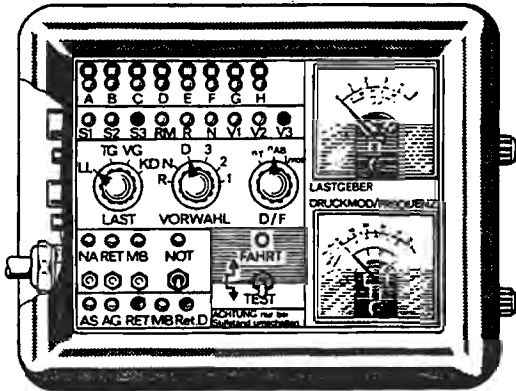
All lamps on transmission display and vehicle mains display must then go out.

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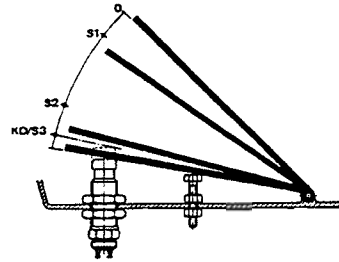
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Test: 2.13 Load sensor



Accelerator position: LL
TG
VG
KD



Note:

Setting:

Result:

(1) Basic setting

(2) Turn rotary knob "LAST" to position "LL".



(3) Press accelerator pedal slowly down to full throttle position (VG).

(1) Reading on the upper meter ranges from app. 0.2 V in idle accelerator position (LL) to app. 2.0 V in full throttle position (VG).

(2) Indicator lamp "RET D":

a) Lights up in idle throttle position (LL).

b) Goes out in part throttle position (TG).

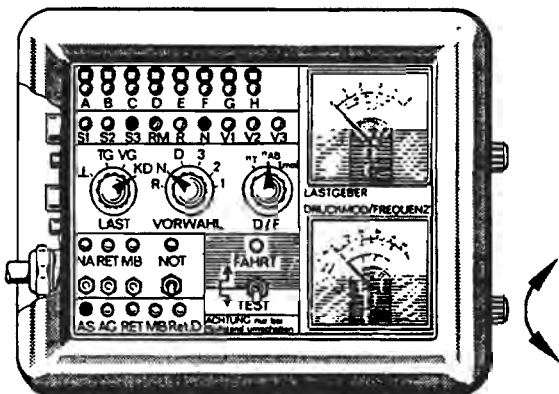
c) Lights up in full throttle and kick-down positions.

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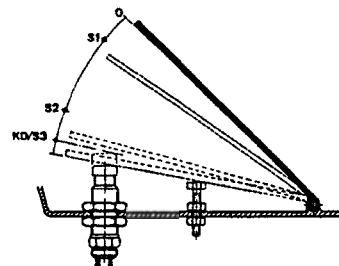
		41
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Test: 2.14 Speed Output (Detent Solenoid Output)



Accelerator position: LL



Note:

Setting:

Result:

(1) Basic setting

(2) Set "VORWAHL" rotary knob to "Neutral"



(3) Turn "ABTR" rotary knob slowly clockwise



Lamp RM comes on (app. 6 km/h)



(4) Turn "ABTR" rotary knob slowly counterclockwise.



Lamp RM goes out.

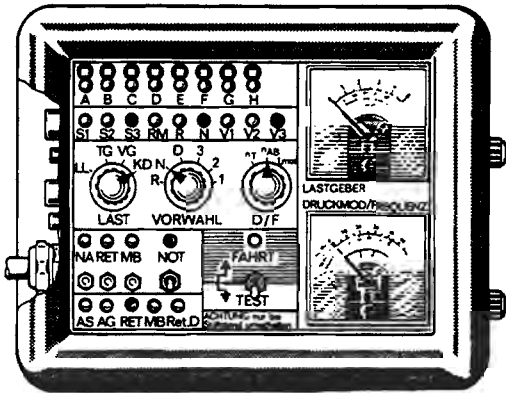
Note:
Detent solenoid is program-dependent.

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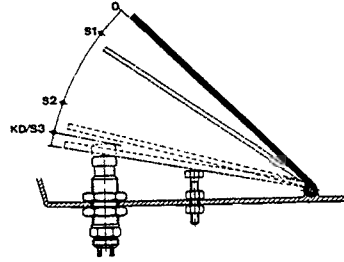
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Test: 2.15 Kick-down switch



Accelerator position: LL
KD



Note:

Setting:

Result:

(1) Basic setting

(2) Press accelerator down as far as kick-down position.

Indicator lamp S3 goes out.

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