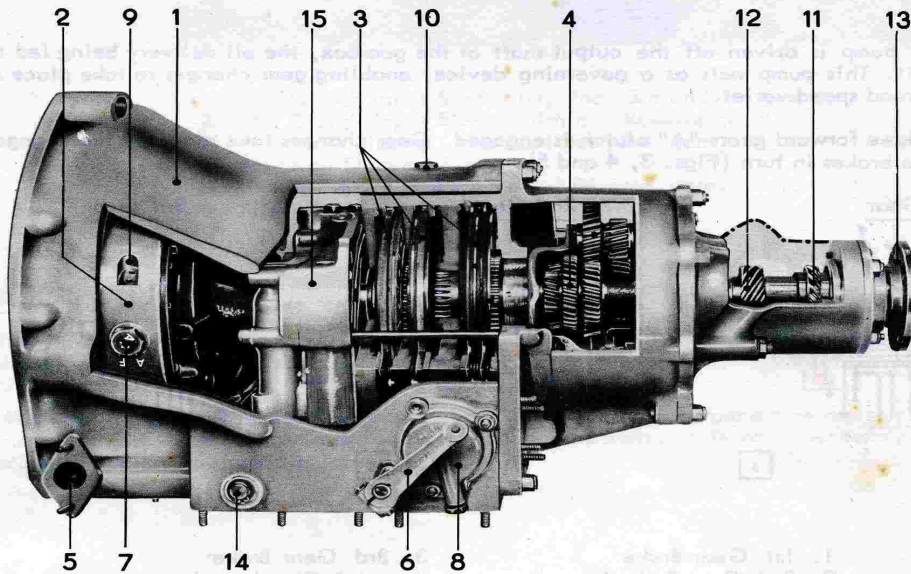




**Borgward-Hansamatic
General Description
and Maintenance**

Bremen, 24.3.1960



1. Gearbox Housing.
2. A & B Clutches.
3. 1st, 2nd & 3rd Brakes.
4. Planetary Gear Train.
5. Oil Filler Pipe Flange.
6. Selector Lever.
7. Floating Valve.
8. Capacity Cylinder.

9. Floating Valve Exhaust.
10. Breather.
11. Speedometer Driving Gear.
12. Rear Oil Pump Driving Gear.
13. Output Flange.
14. Pressure Regulator and Kick Down Shaft.
15. Hydraulic Unit.

Technical Data

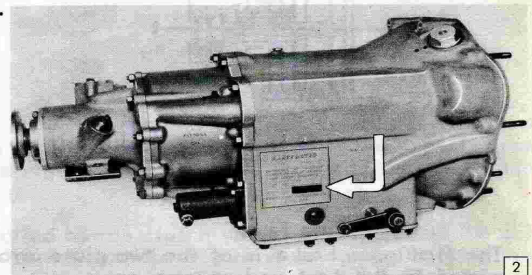
Dry weight of Gearbox and Clutch - 131 lbs. (59,25 Kg).

Gear Ratios:	1st Gear - 3.89 : 1
	2nd Gear - 2.22 : 1
	3rd Gear - 1.49 : 1
	4th Gear - 1 : 1
	Reverse - 4.87 : 1

Oil Requirement - 5 1/2 imp.pints
6 3/4 U.S.liq.pints (3,2 l).

Gearbox No. (see Fig. 2)

Should be quoted when corresponding and ordering spares.



A. Principles of Operation.

1. General description

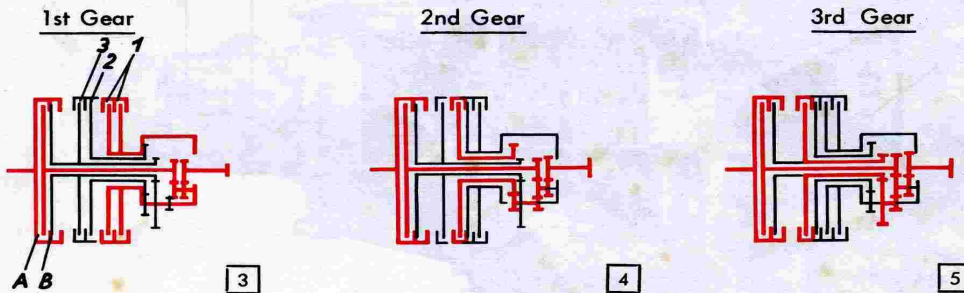
The Borgward-Hansamatic Automatic Gearbox consists basically of a planetary gear train with two hydraulically actuated friction input clutches and three similar reaction brakes.

The two clutches form a self contained unit which is mounted on the engine flywheel. The brakes form another self contained unit which is mounted in the main gearbox casing.

Oil pressure to operate the clutches and brakes is supplied by an engine driven pump: pressure and delivery being controlled by suitable valves which are housed together with the pump in the hydraulic unit.

A second oil pump is driven off the output shaft of the gearbox, the oil delivery being fed to the hydraulic unit. This pump acts as a governing device, enabling gear changes to take place automatically as road speed varies.

In the first three forward gears "A" clutch is engaged. Gear changes take place by the engagement of each of the brakes in turn (Figs. 3, 4 and 5).



1. 1st Gear Brake
2. 2nd Gear Brake

3. 3rd Gear Brake
A and B Clutches

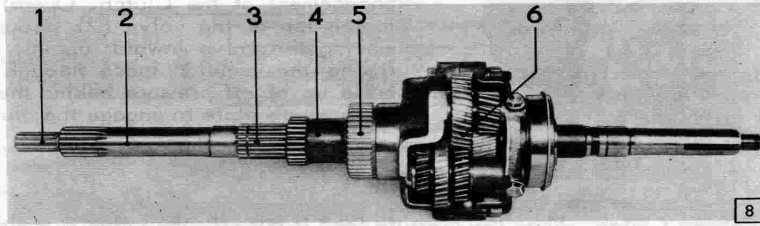
In 4th gear "A" and "B" Clutches are engaged and all brakes released, the gear train is locked and provides a direct drive (Fig. 6).

In reverse gear "B" clutch and 1st gear brake are engaged (Fig. 7).



The first gear brake is of the two plate arrangement in order to resist the high torque that is transmitted in the first and reverse gears.

The gear train is pressure lubricated by the front pump when the engine is running, oil is led to each of the planet spindles, the reaction sleeve bearings, input shaft thrust bearing and the front case bearing.



1. "A" Clutch Input Shaft (1st, 2nd, 3rd and 4th gears).
2. "B" Clutch Input Sleeve (4th and Reverse gear).
3. "B" Input Sleeve, Brake Splines (3rd gear).
4. Reaction Sleeve (2nd Gear).
5. Planet Carrier Brake (1st and Reverse gear).
6. Planetary Gear Train.

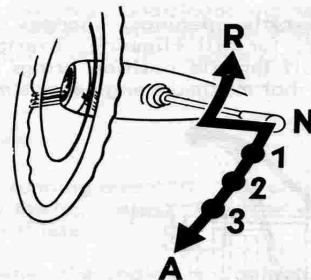
2. Driving.

Starting

The ignition starter switch will not operate unless neutral is selected to prevent the vehicle moving should the accelerator pedal be used when starting the engine, or should the idling speed be too high.

When driving away from cold, with the choke in use it may be found that there is a slight "drag" on the clutch when stationary due to the raised engine revs. it is only necessary to apply the foot brake to prevent the vehicle "creeping".

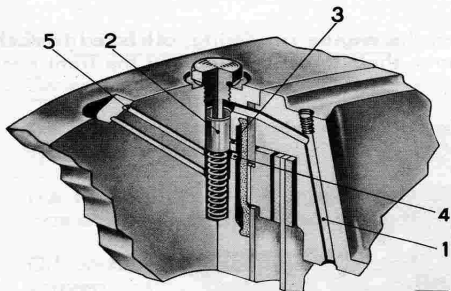
- | | |
|---|-----------------------|
| R | Reverse. |
| N | Neutral. |
| 1 | 1st Gear. |
| 2 | 2nd Gear. |
| 3 | 3rd Gear. |
| A | Automatic (4th Gear). |



Forward Gears.

The automatic position is selected for all normal motoring, and provides completely automatic operation of the gearbox, up and down changes taking place as the speed of the vehicle varies. When the vehicle is stationary with the engine idling the clutch automatically disengages, and it is not necessary to select neutral.

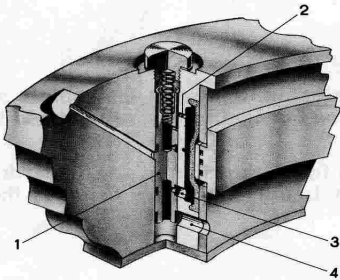
Rapid or smooth engagement of the clutch is controlled by the clutch valves in response to the quick or slow opening of the accelerator pedal. Each clutch has a floating valve and a trafficking valve which operate as follows:



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Disengagement of the Clutch. When the pressure feed is cut off, the valve is moved outwards by the spring and centrifugal force, causing the oil to be flung out of the exhaust port (4) and through the drilling (5) to exhaust.

Trafficking Valves (Fig. 11) are provided so that the clutches will automatically disengage when the engine is brought to rest with the engine running.



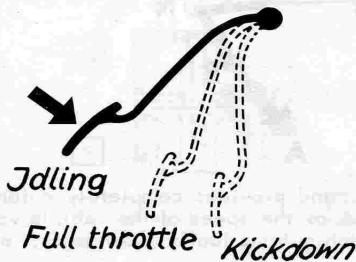
11

Disengagement of the Clutch with the engine running at idling speed, the centrifugal force acting outwards, and oil pressure acting inwards through the orifice (2) balance the valve (1) in what is termed the "trafficking" position, where operating oil is exhausted through the drillings (3) and (4), thereby reducing the pressure in the annular space so that the clutch is disengaged.

Engagement of the Clutch. When the engine is speeded up, increased centrifugal force causes the valve to move outwards, so that the exhaust is shut off and pressure built up in the annular space bringing the clutch into engagement.

Kickdown.

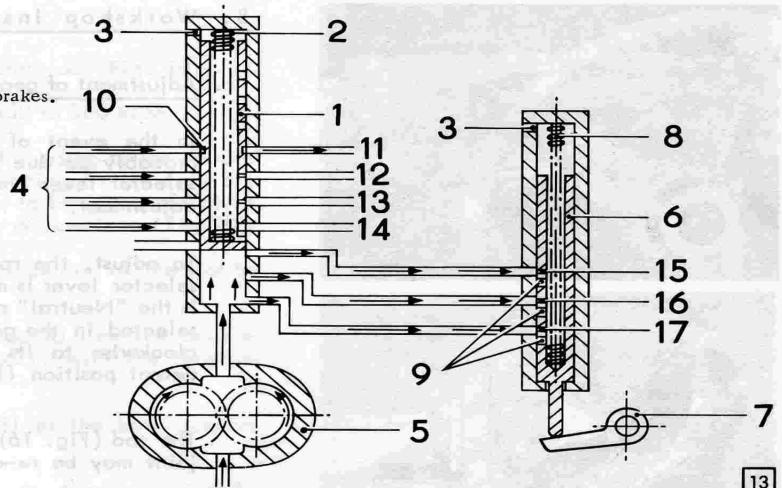
For all normal throttle openings, changes occur at the same speed, when extra engine power is required however, for hill climbing, overtaking, or fast acceleration, depressing the accelerator pedal past the full throttle position brings a "kickdown" mechanism into operation, giving higher change speeds so that maximum engine revs. may be used.



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The accelerator pedal is linked to the gear box with rods, a lever in the gearbox actuates the kickdown valve (Fig. 13).

1. Governor Valve.
2. Spring.
3. Exhaust Port.
4. Pressure supply for "B" Clutch and brakes.
5. Rear Pump.
6. Kickdown Valve.
7. Lever.
8. Kickdown Valve return spring.
9. Kickdown Jets.
10. Annular Groove.
11. To "B" Clutch.
12. To 3rd Gear Brake.
13. To 2nd Gear Brake.
14. To 1st Gear Brake.
15. 3rd Gear Normal Jet.
16. 2nd Gear Normal Jet.
17. 1st Gear Normal Jet.



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When the accelerator pedal is depressed passed the full throttle position the lever (7) lifts the kickdown valve (6).

The kickdown valve has six restricted orifices or jets, three of these are of larger diameter and are the kickdown jets (9), when the accelerator pedal is between the idling and full throttle positions, rear pump pressure is exhausted through the smaller jets (15, 16, and 17). In the kickdown position, pressure is exhausted through the three larger jets, the pressure acting on the governor valve (1) is reduced and the valve moves under the influence of the spring (2). The annular groove (10) connects the next lower brake to the pressure supply, thus engaging a lower gear.

The governor valve is fitted with a spring loaded detent, to ensure that the changeover in position is made instantaneously.

Selector lever position 1-2-3 (see Fig. 9)

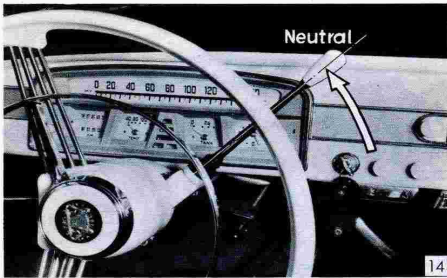
When 1st 2nd or 3rd gear position is selected, automatic gear changing takes place up to and including the selected gear. Moving the lever to any of these positions at a suitable speed will cause a down change to take place, an advantage, if for example, additional engine braking is required for descending a steep hill. The hydraulic unit is designed so that if an indirect gear position is selected at excessive speed, the change does not take place. This avoids any danger of damage to the engine.

Tow Starting.

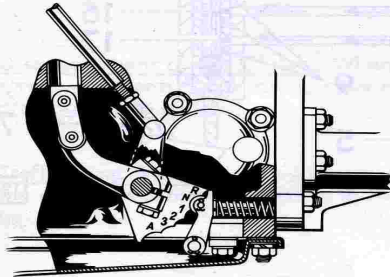
The vehicle may be started by pushing, towing or running downhill. It is only necessary to select "Automatic" and open the throttle. When starting by towing, select "Neutral" as soon as the engine starts to avoid the possibility of ramming the towing vehicle.

The tow start valve is a simple two position valve, when the engine is running it is moved over into the normal running position and the transmission functions normally. When the engine is stopped the valve is moved by a spring into the tow starting position, in this position the rear pump pressure is re-directed to operate the "A" clutch and 3rd gear brake to start the engine if "Automatic" is selected. Whenever the engine is started the valve is moved over by front pump pressure to the running position.

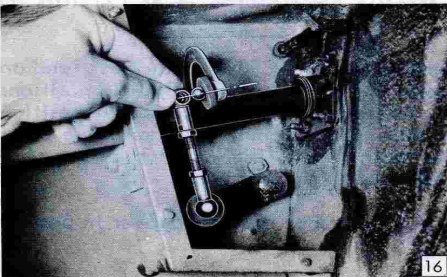
If the vehicle is to be towed other than for the purpose of starting the engine, "Neutral" should be selected, it is advisable to remove the propeller shaft if more than 30 miles is to be covered.



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B. Workshop Instructions

1. Adjustment of gear selection mechanism

In the event of faulty selection, the trouble will probably be due to the external linkage between the selector lever and gearbox, being damaged or out of adjustment.

To adjust, the rod (Fig. 16) is disconnected and the selector lever is moved upwards against the stop, this is the "Neutral" position (Fig. 14). "Neutral" is also selected in the gearbox by turning the external lever clockwise to its fullest extent and then back one detent position (Fig. 15).

The rod (Fig. 16) is adjusted for length so the ball joint may be re-attached without moving the levers.

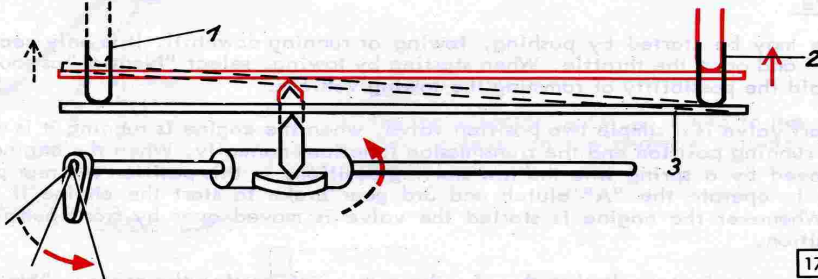
The linkage to the switch mounted in the engine compartment is adjusted so that the starter will operate only when "Neutral" is selected.

The switch has two functions.

1. To make the starter inoperative except when "Neutral" is selected.
2. To operate the reversing lights when "Reverse" is selected.

2. Adjustment of linkage to pressure regulator and kickdown valve.

The accelerator pedal is linked to the gearbox with rods to control the pressure regulator (Fig. 17/1) and the kickdown valve (Fig. 17/2). The linkage is so arranged that the pressure regulator lifts as the accelerator pedal is depressed, the regulator pin reaching the end of its travel when full throttle is obtained at the carburettor. Further movement of the accelerator pedal lifts the kickdown valve. It is most important that adjustment of the linkage is properly carried out. That the position of maximum lift of the regulator pin coincides with full throttle, and at minimum throttle the regulator pin is fully released, with the minimum of free play between the regulator pin (Fig. 17/1) and the beam (Fig. 17/3).



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Adjustment Sequence.

1. Disconnect the throttle regulator rod (Fig. 18).
2. Adjust engine idling speed to 450 to 500 RPM.
3. Disconnect the rod (Fig. 19/3) leading to the double lever (Fig. 19/1). The rod leading from the double lever to the gearbox is adjusted to bring the rod pivot vertically below the slot in the double lever (Fig. 20).
4. The ball joint is moved to the centre of the slot in the double lever.
5. The rod (Fig. 19/3) is adjusted to link the double lever, to the lever (Fig. 19/2), with the throttle closed.
6. Disconnect the rod (Fig. 19/3) at the ball joint of the double lever.
7. Move the lever (Fig. 19/2) to the full throttle position. Move the double lever to the full throttle position.

Note! The full throttle position of the double lever (Fig. 19/1) may be found by moving the lever to the rear against spring pressure, when additional spring pressure will be felt at about three quarters of full travel.

8. With both levers at the full throttle position the socket joint of the rods should just reach the ball on the lever, if it does not the ball should be moved up or down in the slot.

Note!

If the rod is too long the ball must be moved upwards.

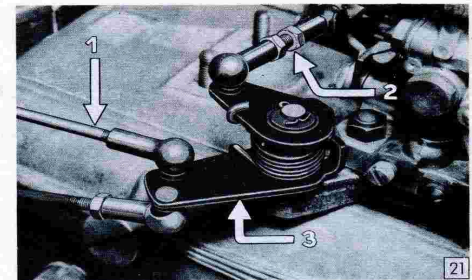
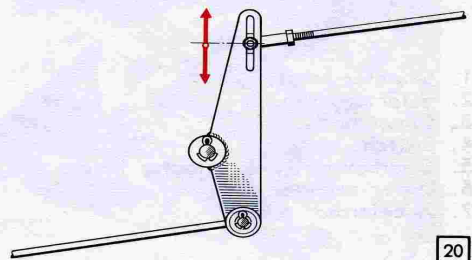
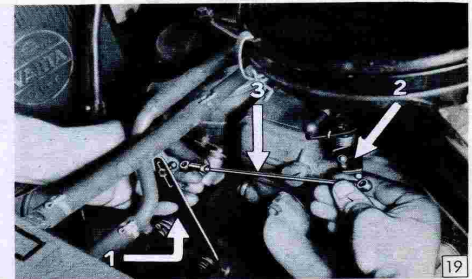
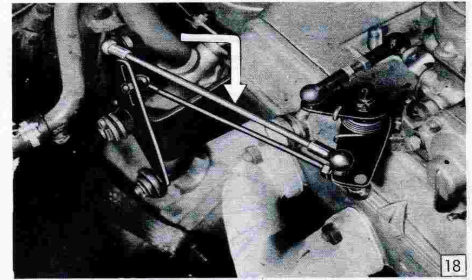
If the rod is too short the ball must be moved downwards.

9. If the ball is moved in the slot, the two levers must again be placed in the "idling" position and the rod adjusted for length (Fig. 20).

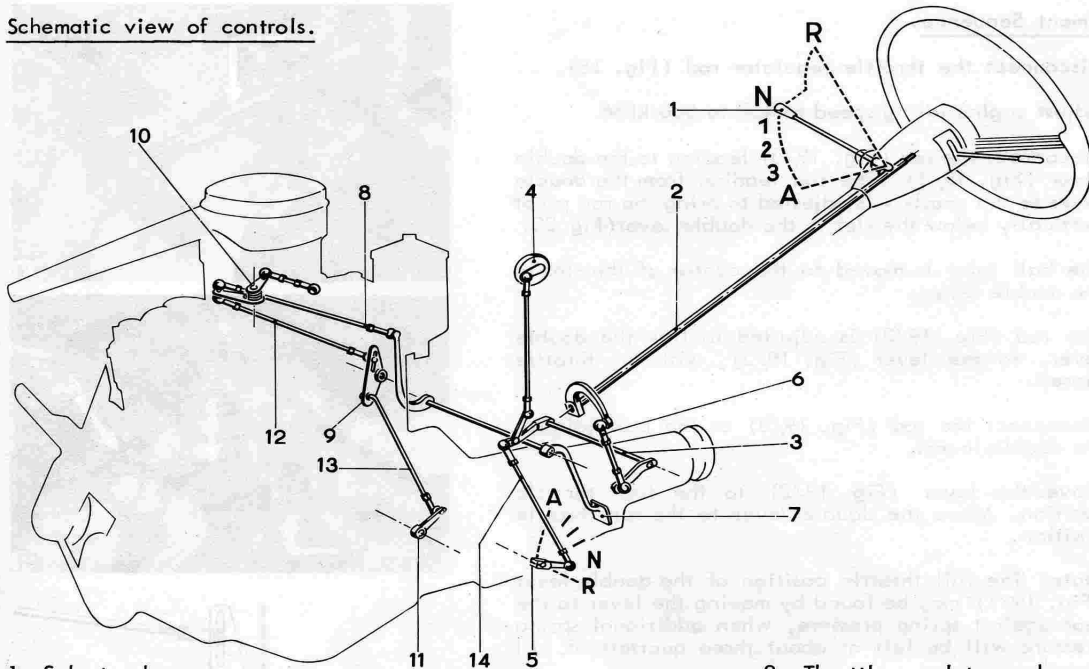
Note!

Correct adjustment is obtained, when the rod may be connected to the lever at the carburettor and the double lever, in both the idling and full throttle positions, without alteration of length.

10. Should the accelerator pedal come up against the toe board before full kickdown is obtained, the rod (Fig. 21/1) should be shortened.
11. With the accelerator pedal in the full throttle position, should it be found that the angle made by the lever (Fig. 21/3) and the rod (Fig. 21/1) is too large, the rod (Fig. 21/2) should be lengthened. In which case the two rods connected to the lever (Fig. 21/3) will require re-adjusting.



Schematic view of controls.



1. Selector lever.
2. Selector shaft.
3. Cross shaft.
4. Switch.
5. Gearbox mounted selector lever.
6. Upper selector rod.
7. Accelerator pedal.

8. Throttle regulator rod.
9. Double lever.
10. Double lever with spring link.
11. Kickdown lever.
12. Upper kickdown rod.
13. Lower kickdown rod.
14. Lower selector rod.

3. ROUTINE MAINTENANCE.

a) Oilchange

(After the first 300 miles (500 km.) and subsequently every 7,500 miles (12,000 km.).)

To drain oil, remove sump plug (Fig. 23).

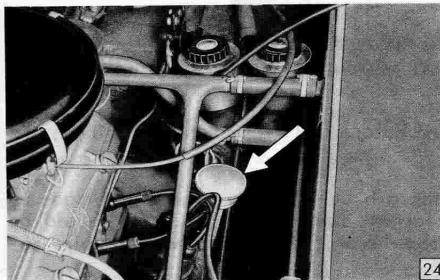
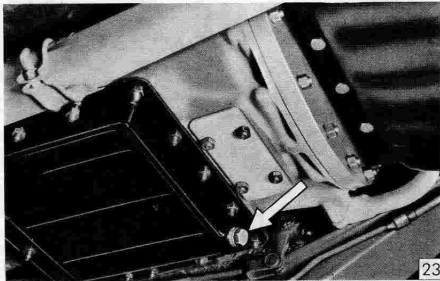
Remove and clean filter as in paragraph C.

Oil filler (see Fig. 24), when adding oil the utmost cleanliness is essential. Add oil from sealed tins. Any measure or funnel used should be washed in petrol and blown off with compressed air.

Oil requirement: 5 1/2 imp. pints; 6 3/4 U.S. liq. pints.

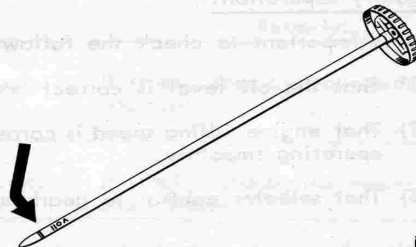
The following oils only are recommended; and they may be mixed without harmful result.

- Caltex 3528 Texamatic Fluid.
- Castrol TQ
- Esso Automatic Transmission Fluid 55
- Mobil Fluid 200 y
- Shell Donax T6



- b) Check Oil level every 2.500 miles (4.000 km).

The dipstick is attached to the oil filler cap, oil level should be checked with the engine switched off, and topped up to the mark on the dipstick if required (Fig. 25).

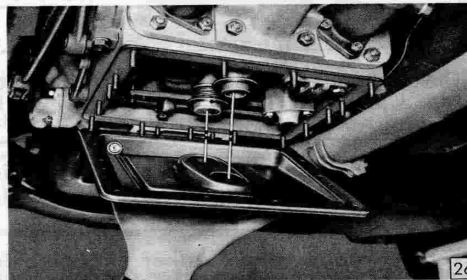


25

- c) Remove and clean oil filter.

(After the first 300 miles (500 km.), and subsequently every 7,500 miles (12.000 km.)).

Drain oil, remove sump, sump stiffener and gasket (Fig. 26), clean filter in petrol (Fig. 27). When replacing, place the filter in the sump with the filterholes in line with the suction pipes (Fig.26). Renew gasket and replace stiffener.



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- d) Check controls.

Check controls every 2,500 miles (4.000 km.). When necessary adjust as in paragraphs 6 and 7.

- e) Check engine idling speed.

Road Test.

Check that starter operates only when "Neutral" is selected. With engine at normal running temperature, select "Automatic". There should be no "creep" on level ground. Depress accelerator pedal slightly, take up of drive should be smooth and instantaneous.



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Clutch Test.

Apply footbrake, and depress accelerator fully. Engine revs. should not rise above 2,000 r.p.m. Do not allow clutch to slip against brakes for more than three seconds, this is sufficient for test and prolonged slip will cause excessive heat to be developed.

A "whining" noise from the gearbox during this test indicates gearbox brake slip.

With the selector lever in the "Automatic" position the change speeds may be checked.

Approximate upward change speeds.

	Normal	Kickdown
Second Gear	4 mph (7 km/h)	22 mph (35 km/h)
Third Gear	17 mph (28 km/h)	40 mph (65 km/h)
Fourth Gear	30 mph (48 km/h)	63 mph (100 km/h)

Approximate downward change speeds.

	Normal	Kickdown
First Gear	2 mph (3 km/h)	---
Second Gear	12 mph (20 km/h)	28 mph (45 km/h)
Third Gear	25 mph (40 km/h)	47 mph (75 km/h)

When a gear change is taking place it is not necessary to release the accelerator pedal.

A momentary rise in engine revs as a change takes place indicates clutch or brake slip.

4. Faulty Operation.

It is important to check the following points before proceeding with any work on the transmission.

- 1) That the oil level is correct and that the oil is of a recommended grade.
- 2) That engine idling speed is correct, with throttle connection to gearbox correctly adjusted, and operating smoothly.
- 3) That selector control to gearbox is operating smoothly, with correct selection.

DIAGNOSIS OF FAULTS

Symptom	Probable Fault	Remedy
1. Down changes occur at high speed, particularly on heavy braking or descending hills.	Filter clogged. Low oil level.	Remove and clean. Top up as required. Check rear pump suction pipe. Ensure that gasket is not damaged.
2. Vehicle "creeps" excessively when either Automatic or Reverse is selected.	Engine idling speed too high.	Set to correct speed.
3. Engine stalls when either Automatic or Reverse is selected.	Engine idling incorrect. Probably too low and uneven.	Set to correct speed.
4. Engine stalls when Forward positions are selected, but not in Reverse. Engine idling at correct speed.	"A" Trafficating valve not moving freely.	Free valve, clean and replace.
5. Engine stalls when Reverse is selected, but not in Automatic. Engine idling correct.	"B" Trafficating valve not moving freely.	Free valve, clean, and replace.
6. Clutch and brake slip in evidence on light throttle take-up. Full throttle performance normal. Possible reluctance of kick-down operation.	Throttle controls set with too much clearance between regulator cam and crossbeam.	Adjust to correct setting.
7. Severe slip on take-up. Slow gear changes with prolonged slip. Kickdown fails to operate.	Throttle controls badly out of adjustment or disconnected.	Check controls thoroughly. Replace worn ball joints or clevis pins etc. Lubricate and re-set.
8. Severe clutch and brake slip on take-up, and/or delayed take-up Forward and Reverse. Gear changes may be slow with prolonged slip. (Throttle controls correctly set)	Clutch relief valve stuck open.	Check pressure on capacity cylinders. If all low: Check clutch relief valve for free movement. If stuck: Free by movement, clean and replace. If free: A leak in the clutch circuit is indicated. Possibly due to worn clutch feed sealing rings. If the unit is new; sealing rings may have been broken or damaged on assembly.

(See KD-Bulletin PKW 1/32-37/5)

Symptom	Probable Fault	Remedy
9. Similar symptoms to above, but take-up and drive in Reverse is satisfactory.	"A" Trafficking valve stuck. "A" Floating valve stuck.	If stuck, free by movement, clean and replace.
10. Slip and delayed take-up in Reverse.	"B" Trafficking valve stuck. "B" Floating valve stuck.	If stuck, free by movement, clean and replace.
11. Car moves forwards in Neutral.	"A" Floating valve stuck.	Free by movement and replace.
12. Car moves backwards in Neutral.	"B" Floating valve stuck.	Free by movement and replace.
13. Car does not move freely forwards.	"B" Floating valve stuck.	Free by movement and replace.
14. Car does not move freely backwards.	"A" Floating valve stuck.	Free by movement and replace.
15. Lack of acceleration when kicking down from 4th to 3rd. Feeling of drag in transmission.	"B" Floating valve not moving freely.	Free by movement and replace. <u>Do not drive car until this fault is corrected.</u>
16. Slip in take-up forward and reverse. Change 1 - 2 slow, with prolonged slip. Drive in 3rd satisfactory, with satisfactory changes 3 - 4 and 4 - 3.	Brake relief valve stuck open.	Check pressure on capacity cylinders. If 3rd is satisfactory, but 1st and 2nd low check brake relief valve. If stuck, free and clean. (See KD-Bulletin PKW 1/32-37/5)
17. Brake slip on take-up, forward and reverse, with a "gap" on 1 - 2 change. Unit drives satisfactorily in 2nd gear. Operation otherwise satisfactory.	Leak on 1st gear capacity cylinder or connections.	Check pressure on 1st gear capacity cylinder. If low, remove cylinder, checking connections for leaks, check that piston is free, and replace. Renew "O" ring. (See KD-Bulletin LKW 1/32-37/5)
18. Take-up and drive satisfactory in 1st, brake slip on 2nd with a "gap" on 2 - 3 change.	Leak on 2nd gear capacity cylinder or connections.	Check pressure on 2nd gear capacity cylinder. If low, remove cylinder, checking connections for leaks, check that piston is free, and replace. Renew "O" ring. (See KD-Bulletin PKW 1/32-37/5)
19. Slip on 3rd gear with a "gap" on 3 - 4 change.	Leak on 3rd gear capacity cylinder or connections.	Check as above for 3rd gear capacity cylinder and connections. (See KD-Bulletin LKW 1/32-37/5)
20. A "gap" on either 1 - 2 or 2 - 3 change. No slip.	Either 1st or 2nd gear capacity cylinder piston sticking.	Remove capacity cylinder concerned and check piston for free movement. (See KD-Bulletin LKW 1/32-37/5)

Symptom	Probable Fault	Remedy
21. A "gap" on 3 - 4 change. No slip.	3rd gear capacity cylinder piston stuck. "B" Floating valve not moving freely.	Check capacity cylinder as above. If fault persists check "B" Floating valve. (See KD-Bulletin LKW 1/32-37/5)
22. Kickdown operates, but is reluctant to release. Change speeds remain high.	Kickdown valve not returning to normal position.	Free valve, and clean. (See KD-Bulletin LKW 1/32-37/5)
23. Gear changes do not occur until speed high and/or drop out changes do not take place, leaving unit in 2nd or 3rd gear when vehicle is brought to rest. Unit may operate satisfactorily when normal running temperature is reached.	Governor valve not moving freely.	Check for free movement. If detent plunger is worn - replace. (See KD-Bulletin LKW 1/32-37/5)
24. Car will not reverse or only at high engine r.p.m. against a resistance.	Governor valve not returned to 1st gear position.	Check for free movement. If detent plunger is worn or damaged - replace. (See KD-Bulletin LKW 1/32-37/5)
25. Gear change speeds correct when unit is cold, but become high when running temperature is reached.	Rear pump cover plate loose. Loose rear pump suction pipe. Rear pump worn.	Tighten nuts. Observe for further leakage. Check suction pipe. Ensure that gasket is not damaged. Remove rear pump. Replace with new unit. (See KD-Bulletin LKW 1/32-37/5)
26. Engine will not start when vehicle is towed.	"A" Trafficking valve not moving freely. Tow start valve stuck in running position.	Free trafficking valve. If fault persists - check tow start valve.
27. Kickdown fails to operate. No slip and unit operation otherwise satisfactory.	Insufficient travel on throttle controls.	Check controls.
28. Drop out down changes bumpy. Hard overrun manual down changes.	Throttle controls set so that cross beam is lifted.	Adjust to correct setting.

If faulty operation is found to have been caused by low oil level, and leakage is suspected, the gearbox should be carefully cleaned to remove road dirt and oil, it should then be examined for leakage after a period of running, and action taken to effect a cure.

5. Removal and Fitting of Clutch Valves.

1. Remove cover plate and gasket (Fig. 28).

2. Allow oil in clutch housing to drain.

3. Remove required valve (Fig. 29).

The valves may be identified by letters, stamped near the valve bores on the clutch valve body.

A.T. = Trafficking Valve.	A Clutch.
B.T. = Trafficking Valve.	B Clutch.
A.F. = Floating Valve.	A Clutch.
B.F. = Floating Valve.	B Clutch.

4. Floating valves are replaced as (Fig. 30) and checked for free movement.

A high standard of care and cleanliness must be observed when fitting valves.

Wash valves in clean petrol and blow off with air.

5. Replace clutch inspection cover and fit new gasket.

6. Make good oil loss.

