Howard 300/350 Rotavator
Service & Repair Manual

Howard®
300/350 Rotavator®

HOWARD

Service
and
Repair Manual

SERVICE MANUAL

INTRODUCTION

This manual has been compiled to give HOWARD * dealers and their staff, a sequence of operations to enable the servicing and repair of a HOWARD * 350 ROTAVATOR * to be carried out quickly and effectively.

Because of our policy of continuous improvement, this manual should always be used in conjunction with the latest Service Bulletins covering the H.350 machine. These Service Bulletins are distributed by us to all HOWARD horticultural dealers when they are first printed, and back issues are available from us on request. Service Bulletins after Bulletin H.60 should be retained at the back of this manual, and a note added to the index of each section affected, so that a convenient record of modifications may be kept.

At the start of each section, there is a list of ordinary workshop tools that will be required when carrying out the repairs covered by that section. Some Special Equipment' may also be required, of which a complete list will be found under 'Specifications' in Section 'A'. Further information concerning 'Special Equipment' can be obtained from our Service department at West Horndon.

In addition to the special equipment used during some repairs, a hydraulic or hand-operated fly press (of the type found in most workshops) will be required when removing and fitting oilseals and bearings.

Before the assembly of component parts, always remove dirt and grease and, in the case of new parts, remove the coating of special rust inhibitor, otherwise the function of the component may be restricted when in operation.

N.B. When ordering spare parts *DO NOT* confuse the illustration numbers used in this manual with the *true* part numbers found in the official parts list.

While every effort is made to ensure that the information contained within this manual is correct, any errors which may occur should be brought to the attention of our Service department.

INDEX

ILLUSTRATION REFERENCE

The figures in brackets after component names refer to:
a. The section and the illustration number within that section.
b. The component number within the illustration.

Example

F1-227 refers to gearbox section 'F', illustration '1', component number 227, which is a cluster gear.

N.B. Illustrations 'E1' and 'F1' will be found as "pull out" pages at the end of their respective sections. These pages should be kept open when referring to the text.

The repair instructions in this manual refer to machines built after machine serial no. 3172608.

A SPECIFICATIONS—HOWARD 300/350

FUEL CAPACITY
1 gallon (4·5 litres)

TRANSMISSION
Transmission is by Vee belt and twin ratio pulley to a gearbox containing two forward speeds, and one reverse (with all gears hardened and running in oil), and a drive shaft of hardened steel mounted on ball bearings. Then by bull-wheel and pinion gears to the land wheels.

CLUTCH
Cone type fitted to the engine crankshaft.

CONTROLS
1. Throttle control by lever and cable.
2. Clutch control by Bowden cable and hand lever.
3. Rod-operated gear lever incorporating safety reverse.
4. Rod-operated rotor engagement lever.
5. Handlebars adjustable for height and sideswing.
6. Depth setting lever.
7. Engine ignition/cut-out switch.

WHEELS
4·00–8 2-ply pneumatic tyres. Tyre pressure 20 psi (1·4 kg/sq cm).

ROTOR
12 in (30·4 cm) diameter rotor (across blades) driven by $\frac{5}{8}$ in (16 mm) pitch roller chain. Rotor speeds 254 rpm and 508 rpm at 2,800 rpm engine speed.

WIDTH OF TILLAGE
16 in (41 cm) or 23 in (58 cm).

DEPTH OF CUT
Adjustable to 6 in (15 cm) maximum.

TRAVEL SPEED (at 3,600 engine rpm)

Low belt ratio	1st	·75 mph (1·2 kph)
	2nd	2·5 mph (4 kph)
	Reverse	1·25 mph (2 kph)
High belt ratio	1st	1·65 mph (2·5 kph)
	2nd	5 mph (8·2 kph)
	Reverse	2·5 mph (4 kph)

OIL CAPACITY
Gearbox—1$\frac{1}{2}$ pints (0·8 litres)
Engine —2 pints (1·1 litres)

RECOMMENDED LUBRICANTS

Gearbox and oiling points	S.A.E. 90
Inner clutch cone spline	Lithium grease
Engine—above 30°F (−1°C)	S.A.E. 30
Engine—between 30°F and 0°F (−1°C and −18°C)	S.A.E. 10 or 10W30
Engine—below 0°F (−18°C)	S.A.E. 5W20

DIMENSIONS (overall)
Length 61 in (155 cm)
Height 38 in (96 cm) (to top of handlebar)
Width 17$\frac{1}{2}$ in (44 cm) (16 in model)
24$\frac{1}{2}$ in (62 cm) (23 in model)

WEIGHT
16 in model 255 lb (115 kg)
23 in model 260 lb (118 kg)

OPTIONAL EXTRA EQUIPMENT

Furrower; Skid Tine; Wheel Weights; Toolbar and Cultivators; Plough; Towing Hitch; Plough Weight and Beam; Axle Extensions; Side Shields; Rotor Conversion Kits (from 16 in to 23 in and conversely); Waterproof Canvas Cover.

SERIAL NUMBER

The serial number of the '350' is stamped on the plate fixed to the left-hand side of the engine support frame beneath the engine, and on the central stem of the handlebar immediately below the handlebar pivot.

NUTS AND BOLTS

All nuts and bolts must be kept tight and the following torque loadings are recommended. In the absence of a suitable torque wrench, spanners of the lengths specified in the right-hand column of the table below will, if used to maximum effect by the average man, give comparable loadings.

Nut size	*Torque*		*Spanner Length*	
	lb/ft	Kg/m	Inches	cms
$\frac{1}{4}$ UNC	8·5	1·2	5	12·5
$\frac{5}{16}$ UNC	17·5	2·4	6	15
$\frac{3}{8}$ UNC	31	4·2	7	17·5
$\frac{7}{16}$ UNC	49·6	6·8	8	20
$\frac{1}{2}$ UNC	73·2	10	10	25
$\frac{9}{16}$ UNC	109·6	15	14	35
$\frac{5}{8}$ UNC	131·9	18·1	18	45
$\frac{3}{4}$ UNC	269	36·9	36	90
$\frac{7}{8}$ UNC	432	59·2	48	120
1 UNC	650	89·1	54	135
$\frac{1}{4}$ UNF	9·5	1·3	5	12·5
$\frac{5}{16}$ UNF	19	2·6	6	15
$\frac{3}{8}$ UNF	33·8	4·6	7	17·5
$\frac{7}{16}$ UNF	54·7	7·5	8	20
$\frac{1}{2}$ UNF	81·2	11·1	10	25
$\frac{9}{16}$ UNF	119	16·3	14	35
$\frac{5}{8}$ UNF	163	22·3	18	45
$\frac{3}{4}$ UNF	283	38·8	36	90
$\frac{7}{8}$ UNF	458	62·7	48	120
1 UNF	688	94·3	54	135

SPECIAL EQUIPMENT

When servicing or repairing an H.350 machine, certain operations should be carried out with the aid of the following special equipment.

RED HERMATITE is a sealing compound used to secure and seal all gaskets to prevent oil leaks, and it should be applied as recommended by the manufacturer.

LOCTITE 'STUD LOCK' is a screw thread locking adhesive used, where specified, to prevent setscrews from vibrating loose, and it should be applied as recommended by the manufacturer.

SPECIAL TOOLS

SPECIAL TOOL S.100 is a machined drift which should be used when removing the bushes, and oilseals, from the axle bearing housing.
When fitting new bushes to the axle bearing housing special tool S.100 should be used complete with the collar.

SPECIAL TOOL S.101 is a machined steel drift which should be used when removing the needle roller bearing, and the oilseals, from the rotor bearing housing.
When fitting a new needle roller bearing to the rotor bearing housing, special tool S.101 should be used complete with the collar.

SPECIAL TOOL S.102 is a machined steel drift which should be used when fitting new oilseals to the rotor bearing housing.

SPECIAL TOOL S.103 is a machined steel drift which should be used when removing the bushes from the final drive and cluster gears. When fitting new bushes to the final drive and cluster gears special tool S.103 should be used complete with the collar.

SPECIAL TOOL S.104 is a machined steel cone which should be used when fitting the rotor drive sprocket to the backplate, and the chaincase to the backplate. This prevents damage to the oilseals in the rotor bearing housing as the splines of the rotor drive sprocket pass through them.

SPECIAL TOOL S.105 is a closed end tube which should be used when fitting a new oilseal to the axle bearing housing.

SPECIAL TOOL S.106 is a special peg spanner which should be used to remove, and refit the special nut which secures the transmission pulley.

SPECIAL TOOL S.107 is a transmission stand which will support the machine and make servicing of the chaincase and gearbox easier.

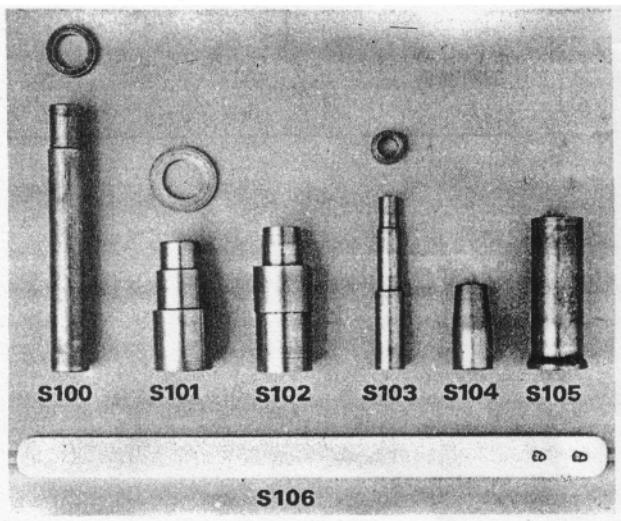


Illustration A1—Special tools S.100-S.106

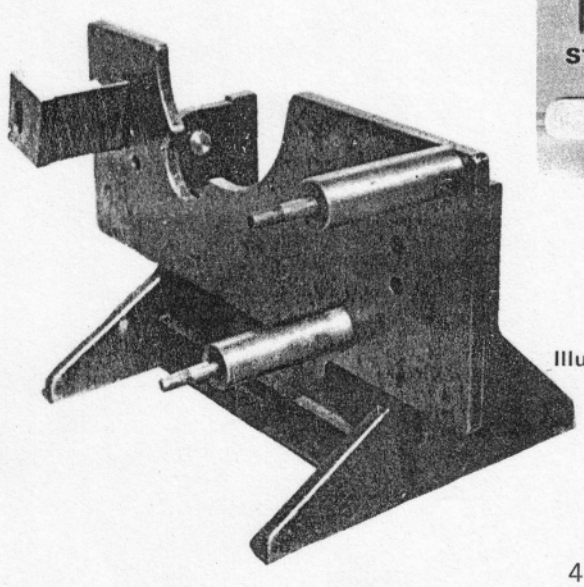


Illustration A2—Transmission stand special tool S.107

HOWARD 300/350—ENGINE B

CONTENTS:

SERVICE BULLETINS APPERTAINING TO THIS SECTION ARE:

Bulletin No.	*Date*

TOOLS REQUIRED WHEN REMOVING/FITTING THE ENGINE

No. off	
1	large screwdriver
1	6 in electrical screwdriver
1	pair 6 in engineers pliers
2	$\frac{9}{16}$ in AF open ended spanners

HISTORY

The first HOWARD 300 machines were fitted with a Briggs and Stratton 4-stroke 4·3 h.p. engine, Model 141200.

From machine serial number 3132828 the engine was changed to a Kohler Model K91 and at machine serial number 3133201 an alternative Kohler engine was introduced, the Model K141, and the machines were designated the 300 and 350 respectively.

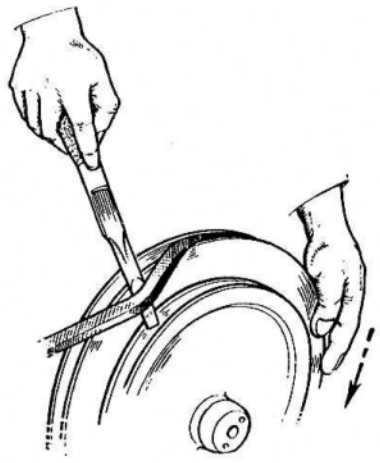
Kohler K91 4-stroke develops 3·1 h.p. at a governed speed of 3600 rpm.
Kohler K141 4-stroke develops 5·3 h.p. at a governed speed of 3600 rpm.

B ENGINE—HOWARD 300/350

TO REMOVE ENGINE FROM MACHINE

1. Switch off, and remove the H.T. lead from the spark plug as a safety precaution.
2. Drain the petrol and oil from the engine (see Engine Manual).
3. Remove the Vee belt safety guard and, with the aid of a screwdriver, remove the Vee belt from the transmission pulley as shown in illustration 'B1'.

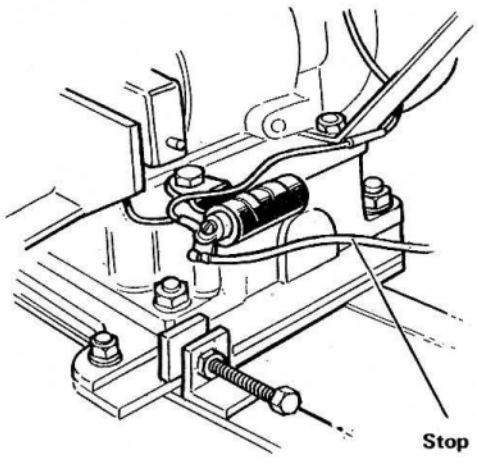
Illustration 'B1'



4. Remove pin (C1–38) and detach the clutch cable clevis (C1–40) from operating arm (C1–3) and slide the cable from its location in the backplate (C1–22).

5. Remove the stop switch cable from the condenser, mounted at the side of the engine, as shown in illustration 'B2'.

Illustration 'B2'



Stop switch cable

N.B. On earlier machines, the condenser is mounted internally and it will be necessary to remove the complete stop switch, and the rubber retaining straps, from the machine handlebars.

6. Disconnect the throttle cable from the carburettor and mark the hole on the throttle quadrant from which the cable is removed, as shown in illustration 'B3', as this will make assembly easier.

7. Remove the four engine sump nuts shown in illustration 'B4'. Do not confuse these with the four studs and nuts which locate the engine baseplate.

8. Remove the engine, by lifting vertically from the main frame, complete with clutch assembly and Vee belt.

Illustration 'B3'

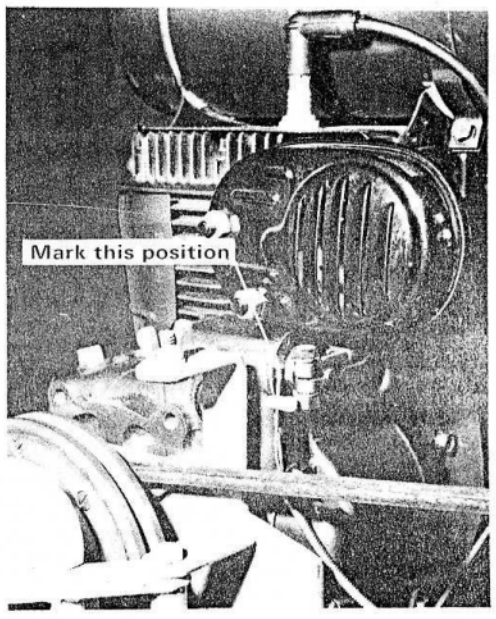
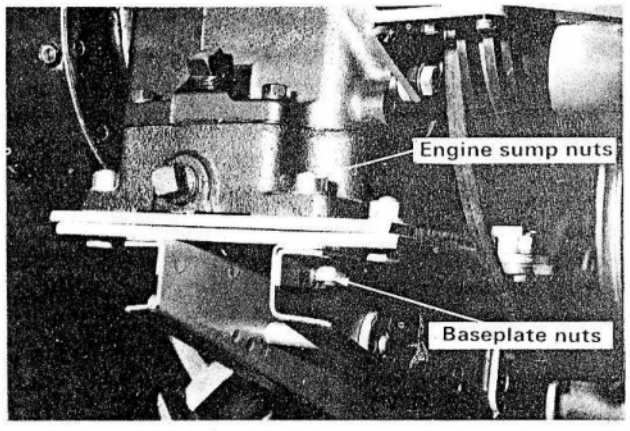


Illustration 'B4'



FOR ENGINE REPAIR INSTRUCTIONS REFER TO ENGINE MANUAL

TO FIT ENGINE TO MACHINE

1. Place the engine and clutch assembly on to the engine baseplate locating on the two sump studs as shown in illustration 'B5'.

2. Insert the remaining two sump bolts and fit and tighten the four nuts.

3. Connect the stop switch cable to the condenser.

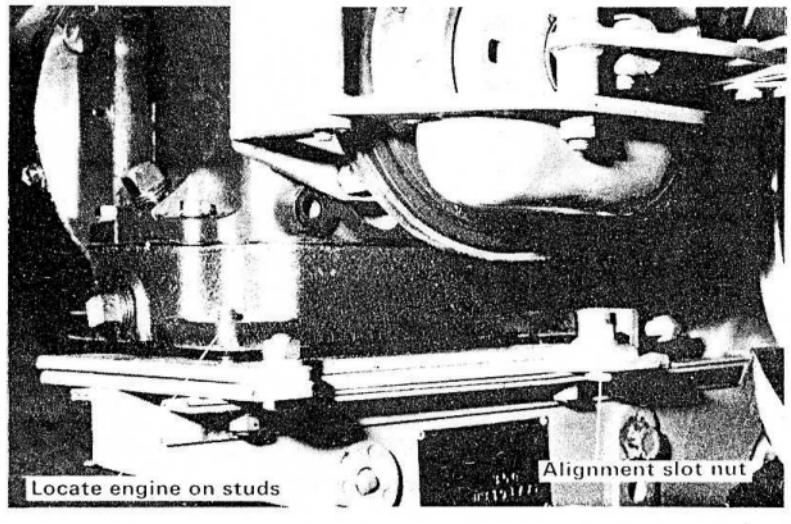
4. Assemble the throttle control cable to the carburettor throttle quadrant ensuring that the cable is inserted in the marked hole.

5. Fit clutch cable clevis (C1–40) on to operating arm (C1–3) using pin (C1–38).

6. Fit the Vee belt onto the transmission pulley and adjust the tension (see clutch adjustments, section C).

7. Fit the Vee belt safety guard.

Illustration 'B5'



B ENGINE—HOWARD 300/350

AIR CLEANER

The air cleaner is one of the most important parts of the engine, and, if correct servicing is carried out, will prolong engine life. If dirt is allowed to get into the engine, excessive wear will occur.

N.B. Before removing the air cleaner, brush or wipe away any loose dirt around the air cleaner body, or air intake horn. This will minimise the risk of dirt entering the engine. When the air cleaner is removed, cover the air intake hole to prevent dirt from falling into the air horn or carburettor. The gasket between the air horn and carburettor must fit tightly to prevent unfiltered air from entering.

Dry paper element type cleaners can be cleaned by removing the element and tapping lightly around the edge causing loose dirt to fall off. The element should be replaced if it is oily or dirt does not drop off easily. The element should be handled with care to avoid perforation. Compressed air should not be used to remove dirt as it will rupture the paper element, making the air cleaner ineffective.

An oil bath air cleaner should be cleaned and refilled with fresh oil as soon as there is an accumulation of dirt in the sediment bowl. Check to ensure that the sealing surfaces of the element are not bent or damaged in any way. Gasket surfaces must seal tightly at the top and bottom of the cleaner shell to prevent unfiltered air from entering the carburettor.

For further engine adjustments and maintenance procedure, refer to engine manual.

HOWARD 300/350—CLUTCH ASSEMBLY C

CONTENTS:

SERVICE BULLETINS APPERTAINING TO THIS SECTION ARE:

Bulletin No.	*Date*

TOOLS REQUIRED WHEN REMOVING/FITTING THE CLUTCH ASSEMBLY

No. off	
1	$\frac{5}{16}$ in AF open ended spanner
1	$\frac{1}{2}$ in AF open ended spanner
1	$\frac{9}{16}$ in AF open ended spanner
1	Pair 6 in engineers pliers
1	Pair 6 in internal circlip pliers
1	Pair 6 in external circlip pliers
1	Large screwdriver
1	1 lb ball pein hammer
1	Small punch
1	$1\frac{1}{4}$ dia soft brass drift
1	3 ft straight edge

SPECIAL EQUIPMENT

'Loctite' stud lock screw thread locking adhesive.

C CLUTCH ASSEMBLY—HOWARD 300/350

HISTORY

On the H.300 machine fitted with the Briggs and Stratton engine a friction disc clutch was fitted up to machine serial number 643; it was then replaced by an improved design of friction disc clutch, which continued in use until the introduction of the cone type clutch.

The cone clutch introduced at machine serial number 2312808 was built from an aluminium inner cone operating in a cast iron outer. From serial number 3161267 it was modified by incorporating friction material on the inner cone face.

The later type of cone clutch cannot be fitted on earlier machines with the Briggs and Stratton engine since this unit relies on the cone clutch inner thrust pad (between the clutch and backplate) to effect the braking of the clutch cone when engaging the gears.

All the instructions in this section refer to illustration 'C1' (unless otherwise stated).

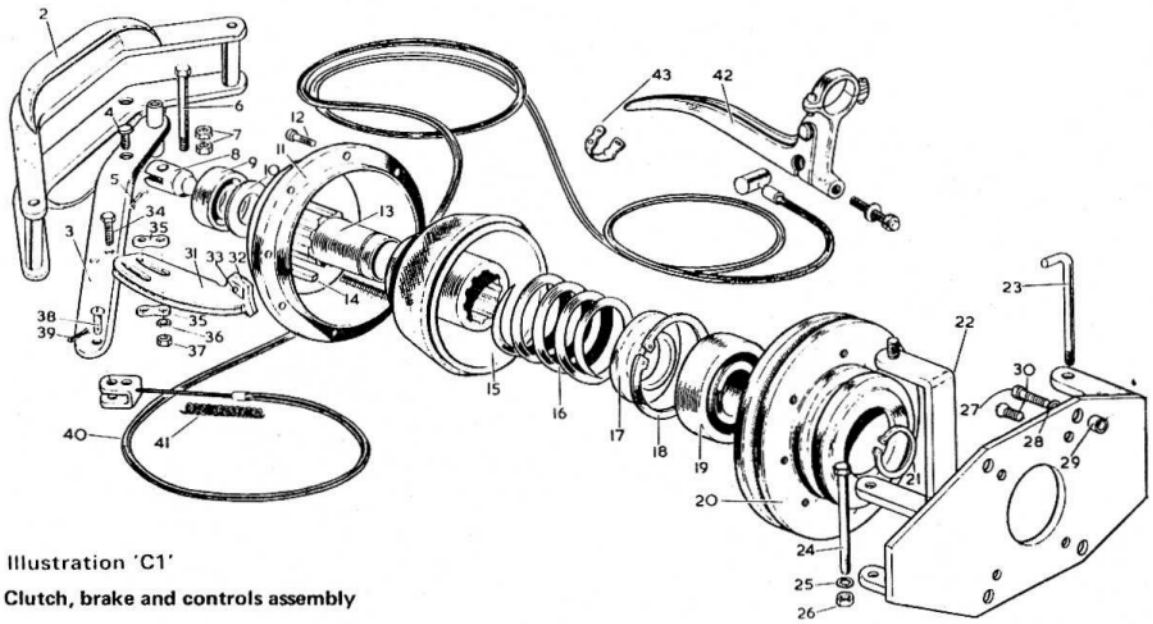


Illustration 'C1'
Clutch, brake and controls assembly

TO REMOVE CLUTCH ASSEMBLY FROM ENGINE

1. Remove the vee belt safety guard.

2. Remove pin (38) and detach the clutch cable clevis (40) from the operating arm (3).

3. Remove locking pin (23) and swing the control frame (2) to the right.

4. Remove the vee belt with the aid of a screwdriver.

The cone clutch may now be withdrawn from the engine crankshaft, complete with locating key (14).

TO DISMANTLE CONE CLUTCH

1. Remove one of the 8 setscrews (12) and lightly clamp the unit upright in a vice, as shown in illustration 'C2' so that the remaining setscrews can be removed without the unit springing apart.

N.B. These setscrews are fitted using 'Loctite' stud lock and the first turn may be difficult.
Remove the assembly from the vice and place on a bench.

2. Lift off the outer cone.

3. Remove the inner cone (15) complete with bearing (9).

4. Remove the bearing (9) from the inner cone using a $1\frac{1}{4}$ in dia soft brass drift, and retain the spacer washer (10).

5. Remove the spring (16) from the drive shaft (13).

6. Remove the external circlip (21) and withdraw the clutch drive shaft (13), from the clutch pulley (20), complete with spring pad (17).

7. Remove the internal circlip (18) and press the bearing (19) from the clutch pulley.

Check all individual parts for wear with particular regard to the working faces of the inner cone (15) and outer cone (11). If the machine has had hard use, checks should be made on the condition of the following:

a. Bearings (9) and (19).

b. Check for slackness between locating key (14) and the keyways in the clutch unit, and on the engine crankshaft.

Slackness in any of these parts will cause clutch 'judder' and they should therefore be replaced.

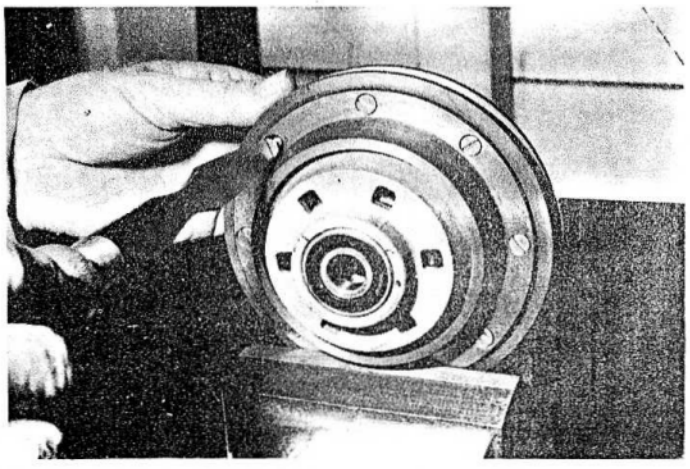


Illustration 'C2'

SEQUENCE OF ASSEMBLING CLUTCH

1. Press bearing (9) into the bore of the clutch pulley (20) and retain using internal circlip (18).

2. Press the drive shaft (13) through the spring pad (17) and into bearing (19).

3. Secure the drive shaft using the external circlip (21).

4. Place spring (16) over the clutch drive shaft.

5. Replace the spacer washer (10) and press bearing (9) into the inner cone (15).

6. Position the inner cone over the drive shaft and onto the spring.

7. Place outer cone (11) onto the inner cone, and with the aid of a vice compress the unit so that the eight setscrews (12) can be inserted.

N.B. The use of 'Loctite' stud lock is recommended when fitting these setscrews. If 'Loctite' is not available, tighten the setscrews and, with the aid of a small punch, burr the metal of the outer cone into the slot on the head of each setscrew.

C CLUTCH ASSEMBLY—HOWARD 300/350

TO REFIT CONE CLUTCH TO ENGINE

1. Position key (14) in the engine crankshaft keyway, and slide the clutch unit onto the shaft.

N.B. The key should be a close fit in the keyway.

2. Swing the control frame (2) into position. Locate the clutch release (8) in the inner cone bearing (9) and ensure that the vee belt is positioned within the frame before inserting the locking pin (23).

3. Fit the clutch cable clevis (40) to the operating arm (3) using pin (38).

N.B. If the spring (41) needs to be replaced, the new spring may be coiled onto the cable, as shown in illustration 'C3'. It is not necessary to detach the clevis bracket from the cable.

4. Refit the drive vee belt.

Clutch adjustments should be made as follows:

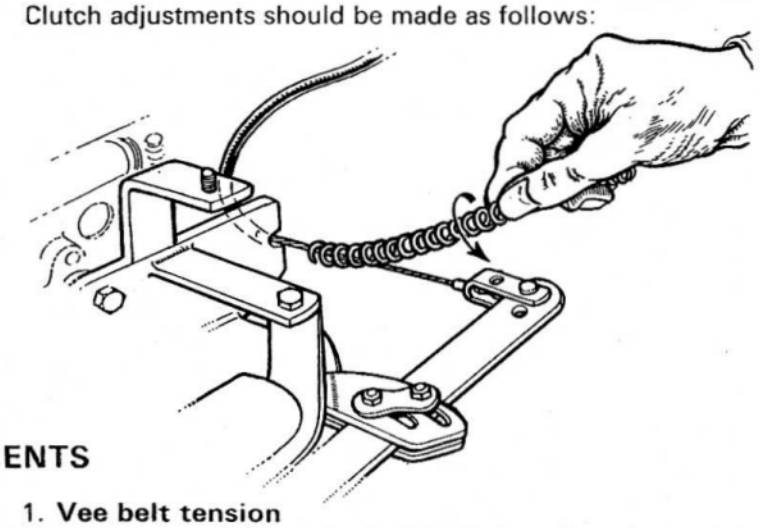


Illustration 'C3'

ADJUSTMENTS

1. **Vee belt tension**

The correct vee belt tension is $\frac{1}{4}$ in (6·4 mm) vertical movement measured at the centre of the belt span, under a load of 6 lbs (3·6 kg), as shown in illustration 'C4'.

The correct tension is obtained as follows:

a. Slacken the four belt tension nuts.

b. Slacken the locknut on the belt tension adjuster.

c. Tighten the belt tension adjuster until the correct tension is obtained in the vee belt.

d. Tighten the locknut on the tension adjuster.

e. Tighten the belt tension nuts.

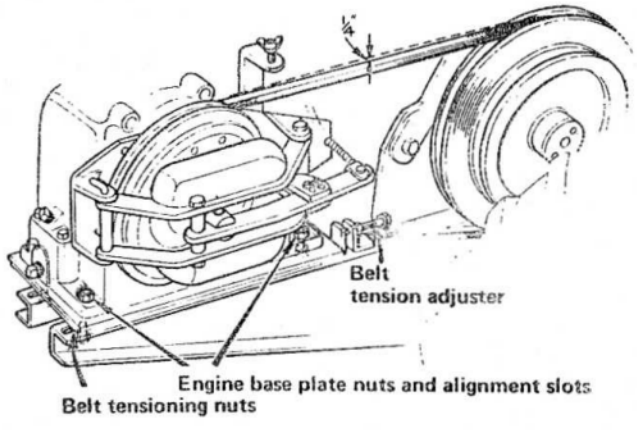


Illustration 'C4'

2. **Pulley alignment**
Alignment of the pulleys should be checked by placing a straight edge across the face of the pulleys, as shown in illustration 'C5'.

Adjustment is made as follows:
a. Slacken the two engine sump nuts (on opposite side of engine to clutch) and the two alignment slot nuts.
b. The engine may now be moved laterally to obtain correct alignment.
c. Tighten the sump and alignment slot nuts.
d. Re-check adjustments (1) and (2). Replace the vee belt safety guard.

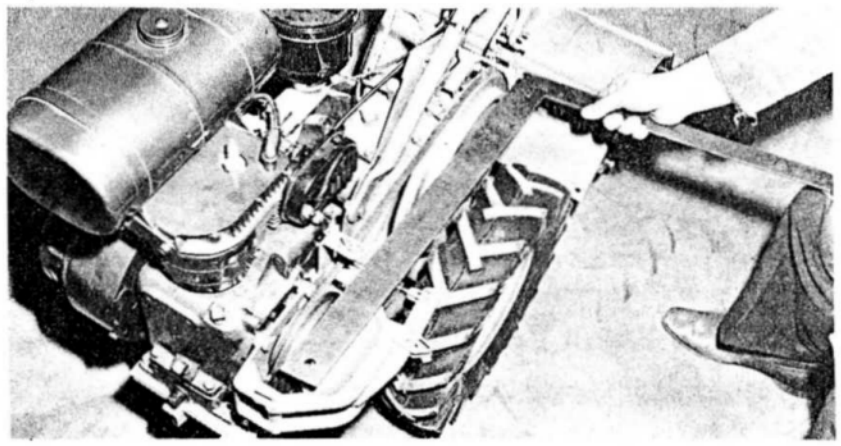


Illustration 'C5'

3. **Clutch adjustment**
The correct adjustment is $\frac{7}{32}$ in (6 mm) free movement at the end of the operating arm, as shown in illustration 'C6'.

Adjustment can be made as follows:
a. Loosen the knurled adjuster screw locknut situated at the front of the clutch lever.
b. Turn the adjuster to obtain correct free movement. Inward movement of the adjuster towards the clutch lever increases the free movement at the end of the operating arm.
c. Tighten the knurled locknut.

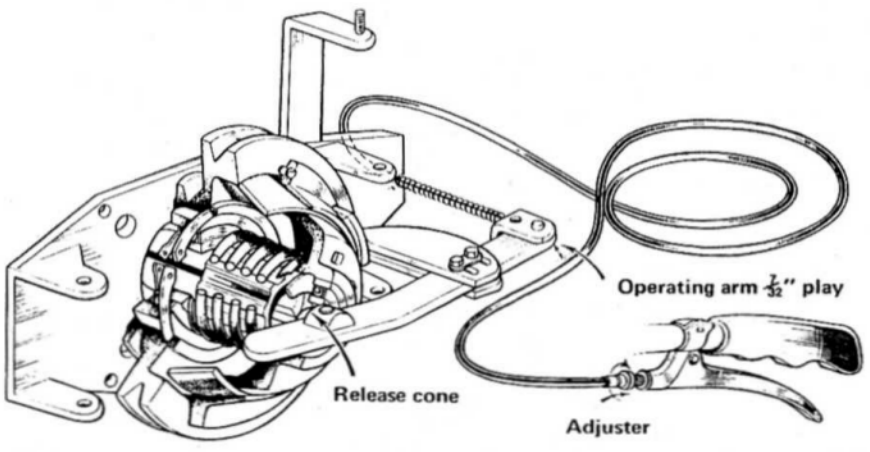


Illustration 'C6'

C CLUTCH ASSEMBLY—HOWARD 300/350

4. **Clutch brake adjustment**
The correct setting for the clutch brake should be $\frac{1}{4}$ in (6·4 mm) clearance between the brake block and the outer cone of the clutch assembly as shown in illustration 'C7'.

Adjustment can be made as follows:
a. Slacken the bolts retaining the brake shoe to the operating arm.

b. Move the brake shoe in the slots provided until the correct clearance of $\frac{1}{4}$ in (6·4 mm) is obtained.

c. Before tightening the retaining bolts to a torque of 4·1 lb/ft(0·56 kg/m) ensure that the angle of the brake shoe is such that the full face of the brake block comes into contact with the outer clutch cone when the clutch is operated.

N.B. If the correct clearance cannot be obtained due to a worn brake block, then this part should be replaced.

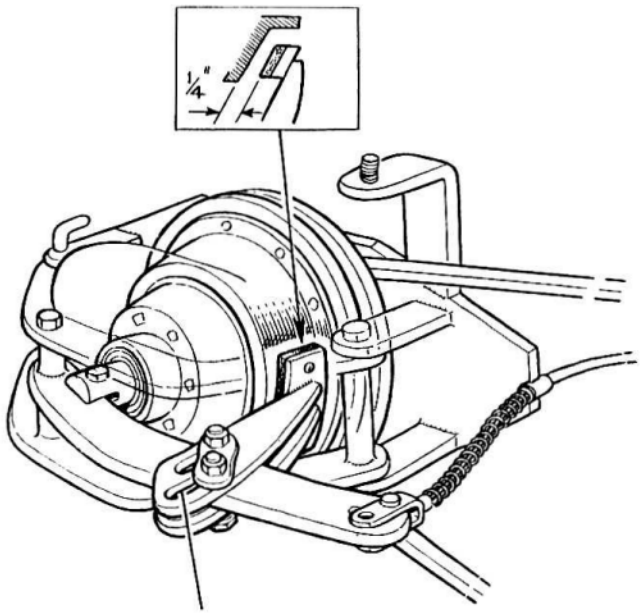


Illustration 'C7'

CLUTCH FAULT FINDING CHART

1. ROTOR DOES NOT MOVE WHEN GEARS ARE ENGAGED

Possible Cause	*Check*
a. Clutch slip	Clearance at clutch release cone and clutch lever (see Adjustments).
	That the operating arm pivot bolt (C1–6) is not too tight.
	That the clutch release (C1–8) is centralised with inner cone bearing (C1–9).
	That the clutch operating spring (C1–16) is not broken.
	That the key (C1–14) is in position on engine crankshaft.
	Spline engagement between inner and outer cone for tightness (free and lubricate).
	That the clutch lining on inner cone (C1–15) is in good condition.
	That the clutch cable is not seizing—lubricate.
b. Vee belt slip.	That the adjustment is correct (if belt slip is still present with all adjustment taken up, replace vee belt).
c. Vee belt comes off.	Pulley alignment. (see Adjustments).

2. DIFFICULTY IN ENGAGING GEARS

Possible Cause	*Check*
a. Clutch not disengaging.	That the clearance between clutch release cone and inner cone bearing is not too great. (see Adjustments).
	That the spline of inner cone slides freely.
b. Clutch brake not operating.	Adjustment between brake shoe assembly (C1–31) and clutch outer cone (see Adjustments).
	Wear on brake block. If no further adjustment is possible replace brake block.

D HOWARD 300/350—ROTOR ASSEMBLY

CONTENTS:

SERVICE BULLETINS APPERTAINING TO THIS SECTION ARE:

Bulletin No.	*Date*

TOOLS REQUIRED WHEN REMOVING/FITTING ROTOR ASSEMBLY

No. off	
1	Pair 6 in engineers pliers
1	Copper/rawhide hammer
1	$\frac{7}{16}$ in AF open ended spanner
2	$\frac{1}{2}$ in AF open ended spanner
2	$\frac{15}{16}$ in AF open ended spanner

DESCRIPTION

A rotor with a splined centre tube is fitted to each end of the rotor drive shaft (E1–72) and is retained by a draw bolt (D1–173) through the centre. This bolt *MUST* be fitted with the locknut (D1–176) at the left hand side of the rotor (looking from behind).

From machine serial number 3151422 a longer draw bolt was used which allows two $\frac{5}{8}$ in UNC locknuts (D1–176) to be used to retain the two rotor halves, in place of the original single $\frac{5}{8}$ in UNC nut.

HOWARD 300/350—ROTOR ASSEMBLY D

TO REMOVE ROTOR ASSEMBLY FROM MACHINE

1. Remove split pin (F1–277) and disconnect rotor selector rod (F1–286).

2. Remove depth skid (D2–319) by tipping the machine forward and releasing the depth control lever (D2–318).

3. Twist and withdraw the rotor shield securing pin (D2–315).

4. Remove second securing pin (D2–316) located at the front bottom edge of the shield, and remove shield (D2–314) complete.

5. Undo rotor draw bolt (D1–173) and withdraw.

6. Remove rotor tubes (D1–176) from the splined rotor drive shaft.

7. Remove rotor spacer washers (E1–166) from each side of rotor drive shaft.

N.B. Spacer washers are only fitted where necessary to give clearance between centre blades and the chaincase.

TO REFIT ROTOR ASSEMBLY TO MACHINE

1. Fit rotor spacers (E1–166) to each side of the rotor drive shaft.

2. Fit rotor tubes to splined rotor shaft ensuring that the blades have their leading edge facing forward. Viewed from the right hand side of the machine the rotor turns clockwise. It is also essential that the correct spline on the rotor drive shaft is selected to give equal spacing of the blades. The rotor tubes should be fitted so that the blade scroll pattern is maintained, ensuring that only one blade can enter the ground at a time, otherwise undue strain will be placed on the transmission.

As a guide the centre blade of the left hand side should be 30° ahead of the centre blade on the right hand side.

3. Insert rotor draw bolt (D1–173) *ALWAYS FROM THE RIGHT HAND SIDE* and fit locknuts (D1–176). Tighten to 131·9 lb/ft (18·1 kg/m) torque.

4. Refit rotor shield (D2–314) and secure with pins (D2–316) and D2–315).

5. Fit depth skid (D2–319) and engage depth control lever (D2–318).

6. Connect rotor selector rod (F1–286).

BLADES

Blades should be fitted as shown in illustration 'D3' equally spaced and in the correct 'scroll' pattern, so that only one blade can enter the ground at a time.

When replacing worn blades, remove one blade at a time replacing it with a new blade of the correct form, making sure that the locating area of the rotor is free from dirt and grease. Insert the special bolts from the *blade side* with the nuts and spring washers against the flange, and tighten to 19 lb/ft torque.

D ROTOR ASSEMBLY—HOWARD 300/350

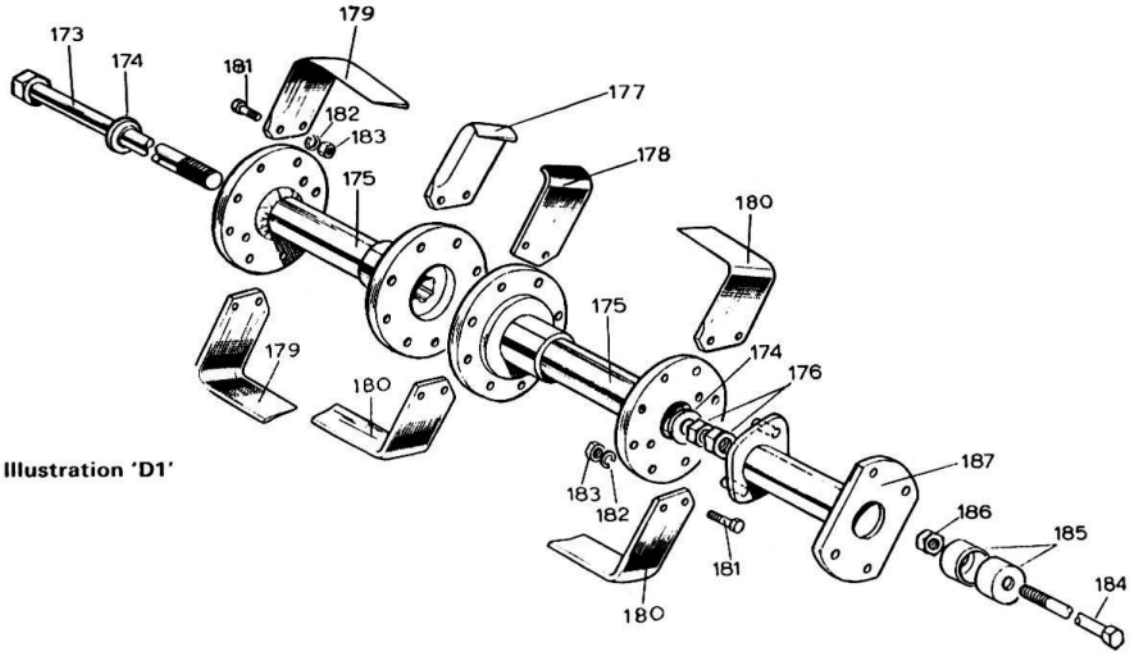


Illustration 'D1'

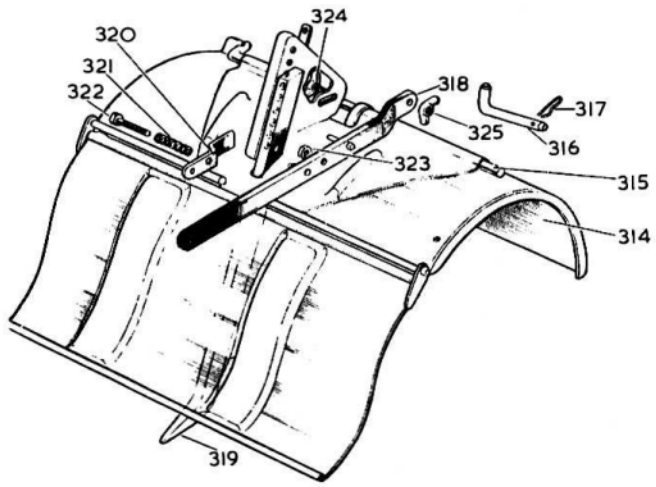
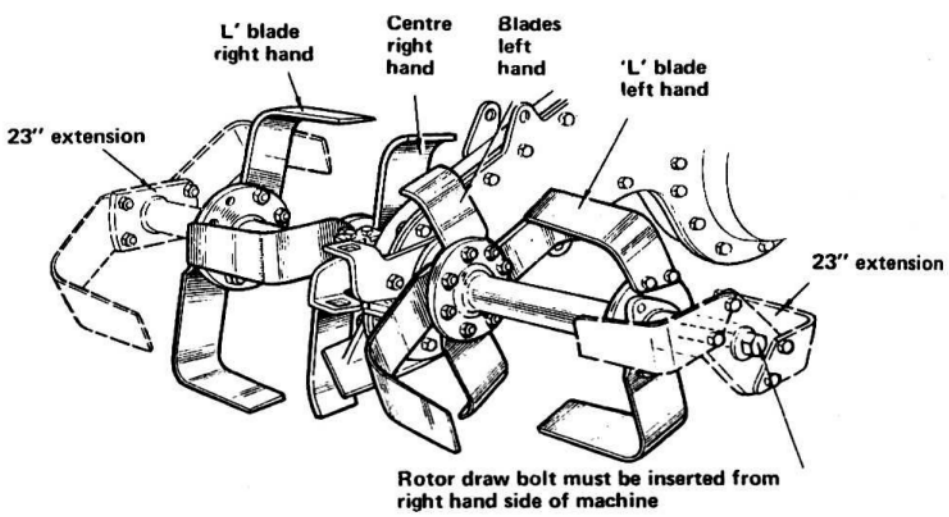


Illustration 'D2'

Illustration 'D3'



ADJUSTMENTS

WEED CUTTER BLADES (E1–110)

Weed cutter blades are fitted on each side of the rotor chaincase, as shown in illustration 'D4', to prevent long grass or weeds from wrapping around the centre of the rotor.

The blades are slotted and secured by two bolts, and should be adjusted so that they just clear the blades when the rotor is turned by hand. Severe power losses will occur in weedy conditions unless these blades are correctly adjusted.

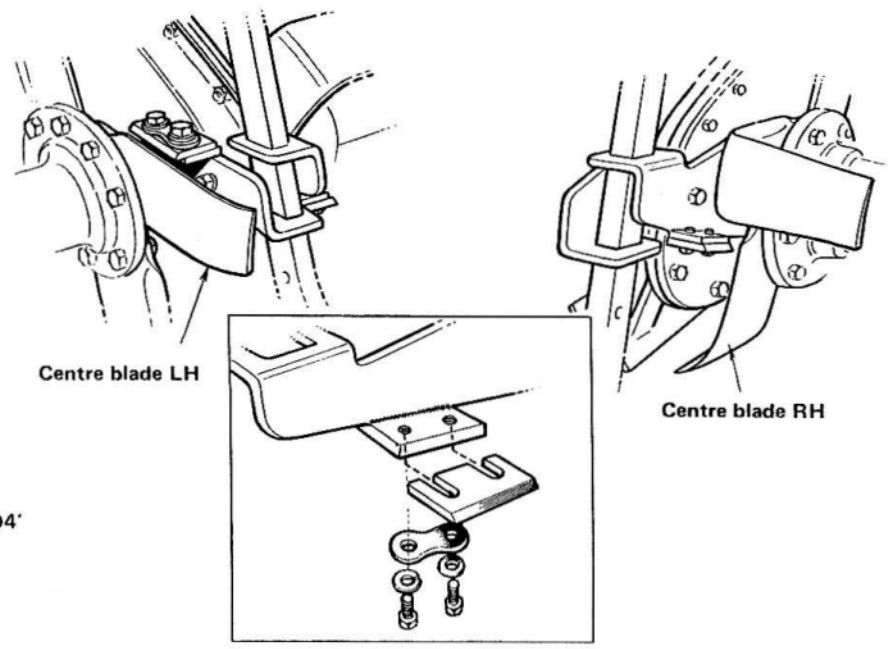


Illustration 'D4'

DEPTH CONTROL HANDLE (D2–318)

The handle on the rotor shield is pushed to the right and raised to increase working depth, or lowered for shallow work. The spring clip (D2–320) which holds the handle in position can be adjusted to the tension required for correct movement of the depth control handle and locked in position by locknut (D2–323).

ROTOR ENGAGEMENT LEVER (F1–286)

To engage the rotor this lever should be moved a quarter turn clockwise, pulled out, then released. To disengage rotor turn clockwise, push in, and release.

CHAIN TENSIONER (E1–125)

To adjust, turn the rotor by hand, and using the adjuster screw on the underside of the chaincase, screw in until resistance is felt in the rotor movement. If the adjuster screws in so far that only $\frac{1}{4}$ in or less of screw thread is still visible, the drive chain should be replaced.

D ROTOR ASSEMBLY—HOWARD 300/350

ROTOR FAULT FINDING CHART

Fault	*Check*
1. Difficulty in engaging rotor.	If rotor selector spring (F1–284) is broken.
	If rotor selector rod (F1–286) requires lubrication.
	If rotor selector rod is bent.
	If clutch is operating correctly.
	That the inner splines of the rotor selector gear (F1–214) and splined drive shaft (F1–211) slide freely.
2. Clogging of rotor.	That the 'scroll' pattern is correct, so that only one blade enters the ground at a time (see Blades and Rotor Assembly).
	That the weed cutter blades are correctly adjusted (see Adjustments).
3. Excessive blade wear.	If blades are bent. Bent blades will waste power and prevent penetration, also the blades will wear more quickly. A suitable bar will enable the operator to straighten bent blades (see Blades). Badly bent blades should be replaced.
4. Excessive 'jumping' of machine.	That the blades and rotor tubes are fitted correctly (blades maybe fitted backwards or rotor tubes fitted to the wrong side of the drive sprocket, i.e. left hand rotor tube on right hand side of drive sprocket).

HOWARD 300/350—CHAINCASE ASSEMBLY E

CONTENTS:

SERVICE BULLETINS APPERTAINING TO THIS SECTION ARE:

Bulletin No.	*Date*

TOOLS REQUIRED WHEN DISMANTLING/ASSEMBLING CHAINCASE/ WHEELS AND WHEEL HUBS

No. off	
2	$\frac{7}{16}$ in AF open ended spanner
2	$\frac{1}{2}$ in AF open ended spanner
1	$\frac{9}{16}$ in AF open ended spanner
2	$\frac{3}{4}$ in AF open ended spanner
1	Large screwdriver
1	I arge Philips screwdriver
1	1 lb ball pein hammer
1	Copper/rawhide hammer
1	$1\frac{15}{16}$ in dia soft brass drift
1	$\frac{1}{4}$ in dia soft brass drift

SPECIAL EQUIPMENT

This special equipment is described under 'Specification Section A.

Special Tools: S.100
S.101
S.102
S.104
S.105
S.107

Red Hermatite gasket sealing compound.

Loctite 'stud lock' screw thread locking adhesive.

E CHAINCASE ASSEMBLY—HOWARD 300/350

DESCRIPTION

The unit is basically in two sections, a chaincase and a backplate, which are bolted together and sealed with a gasket. The wheel axle passes through the transmission assembly and is driven by a large bullwheel gear direct from the gearbox. The rotor drive shaft also passes through the transmission assembly and is driven by a chain from the gearbox.

HISTORY

The transmission unit has remained basically unchanged with the exception of the following modifications.

ROTOR AND AXLE BEARING HOUSINGS

Up to machine serial number 3151727 rotor bearing housing part no. 64335 was fitted, together with two oilseals INAG 30×37×4 per housing. These oilseals were then superseded by an improved version having twin lips per seal, under part no. 261215002, and are a direct replacement for the earlier type seal.

From machine serial number 3151728 rotor bearing housing part no. 68714 together with oilseals part no. 261712023 were introduced. These parts may be fitted to machines prior to serial number 3151728, providing that both housing and oilseal are used.

From machine serial number 3172608 a modification took place to both the rotor and axle bearing housings. Mounting discs part nos. 69206 and 69207 for rotor and axle bearing housings respectively, were introduced to allow the housings to be secured using setscrews in place of the Avdelock bolts. They are positioned on the inside face of both the chaincase and backplate to strengthen the bearing housings and to reduce the possibility of oil leaks.

Although the diameter of the disc used on both bearing housings is the same, the threaded holes are in different position.

BULL WHEEL GEAR

When fitting the modified axle bearing housing part no. 64330 together with disc part no. 62907 to machines prior to machine serial number 3172608, it may be necessary to replace the bull wheel gear part no. 64343. This is because when fitting the disc there may be insufficient clearance between this part and the bull wheel gear hub, and it will therefore be necessary to replace the bull wheel gear with a modified part (having a machined recess of $3\frac{1}{2}$ in dia× 0·25/0·28 in deep on the chaincase side) as shown in illustration 'E2'.

The bull wheel gear must be fitted so that the thicker 'boss' is facing towards the backplate, to ensure correct meshing with the bull pinion.

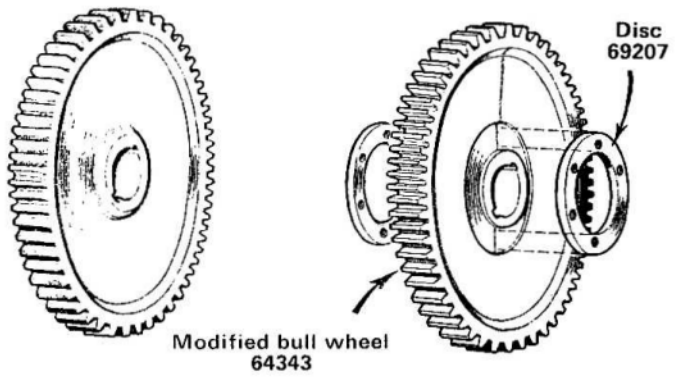


Illustration 'E2'

HOWARD 300/350—CHAINCASE ASSEMBLY E

TO DISMANTLE CHAINCASE

1. Drain the oil from the transmission (see Adjustments Section G).

2. Remove the Engine (Section B).

3. Remove the gearbox (Section F).

Unless otherwise stated the following dismantling instructions refer illustration 'E1' which can be found on page 34.

4. Remove the chaincase skid (133).

5. Remove the engine baseplate (69) complete.

6. Remove bolt (129) and spacer (130) from between the depth skid brackets.

7. Remove all nuts and bolts from around the perimeter of the chaincase.

8. Remove bolt (127) which is the chain tensioner pivot bolt.

9. Remove setscrew (197), shown in illustration 'E3' from the drive sprocket spindle (193).

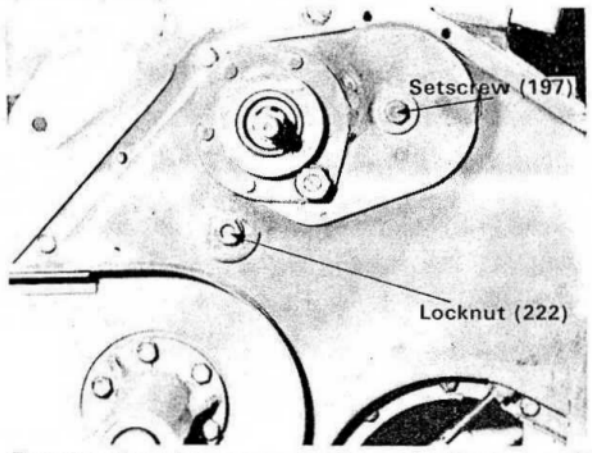


Illustration 'E3

10. Remove the chaincase, as shown in illustration 'E4', leaving the bull wheel gear and the chain drive on the backplate.

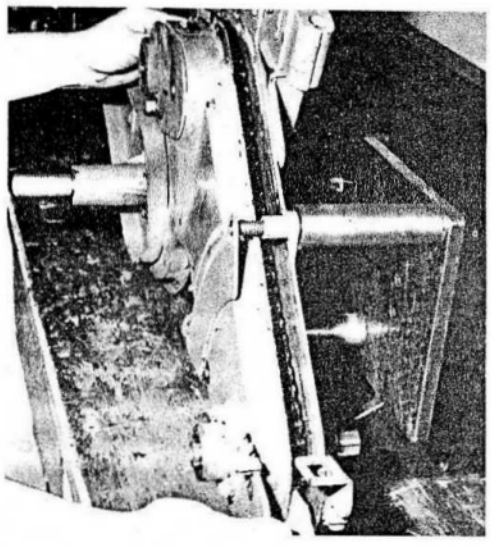


Illustration 'E4'

11. Detach the chain drive, as shown in illustration 'E5', by pulling the rotor drive sprocket (172) and the top drive sprocket (191) from their location simultaneously.

N.B. Do not loosen the thrust washer (190) from the front face of the top drive sprocket.

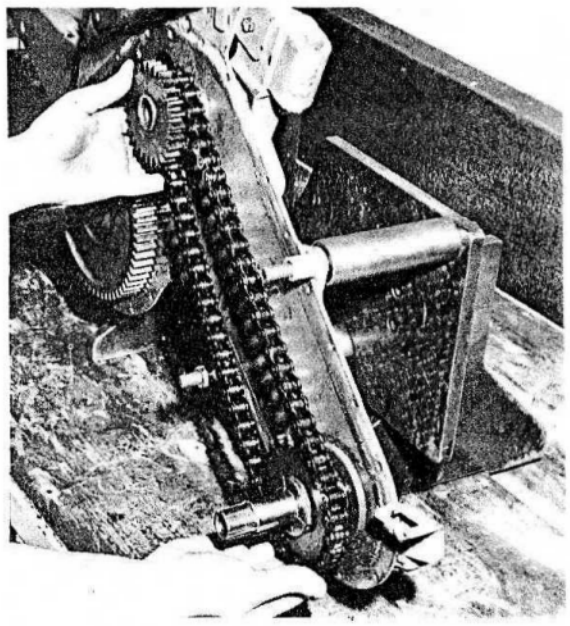


Illustration 'E5'

12. Remove the rear thrust washer (190) from its location against the back-plate on the top drive sprocket spindle (193).

13. Withdraw the bull wheel gear (164) complete with wheel axle (162) and spacers (165). The axle can then be pressed through the bull wheel gear, and key (163) removed from the shaft. Check the key in the keyway for slackness, and if necessary renew the key.

14. **To remove/dismantle rotor bearing housing(s)**
Remove the flangescrews from the rotor bearing housings (102) and remove from the backplate and chaincase, complete with depth skid brackets, and hence remove the discs.

N.B. If removing the rotor bearing housings with the chaincase still in position, the discs, on removal of the setscrews, may drop into the chaincase. It is therefore recommended that two of the setscrews are first removed, and replaced by $\frac{1}{4}$ in UNC studs, which will hold the discs in position, as shown in illustration 'E6'.

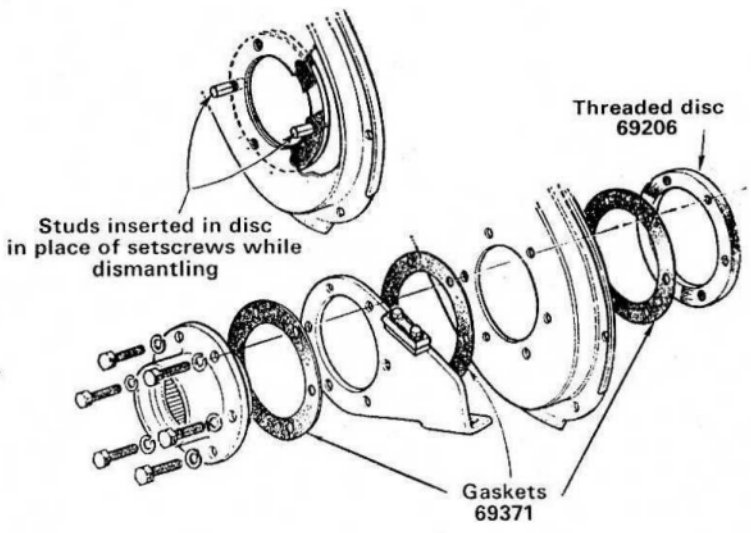


Illustration 'E6'

The oilseals (167) and the needle roller bearing (169) can then be removed from each housing, as shown in illustration 'E7', using special tool S.101 and a suitable press.

N.B. Oilseals and needle roller bearing are pushed out in one operation.

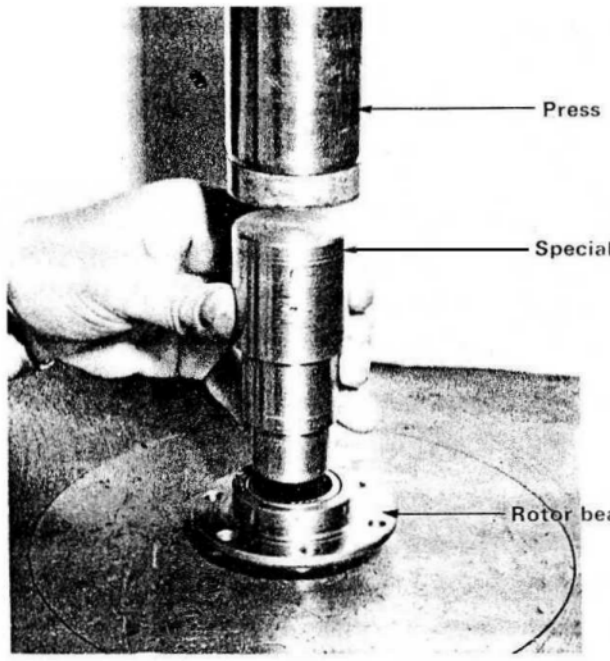


Illustration 'E7'

15. **To remove/dismantle axle bearing housing(s)**
Remove the setscrews from the axle bearing housings (103) and remove from backplate and chaincase, and hence remove the discs.

N.B. If removing the axle bearing housings with the chaincase still in position, the discs, on removal of the setscrews, may drop into the chaincase. It is therefore recommended that two of the setscrews are first removed, and replaced by $\frac{1}{4}$ in UNC studs, which will hold the discs in position as shown in illustration 'E8'.

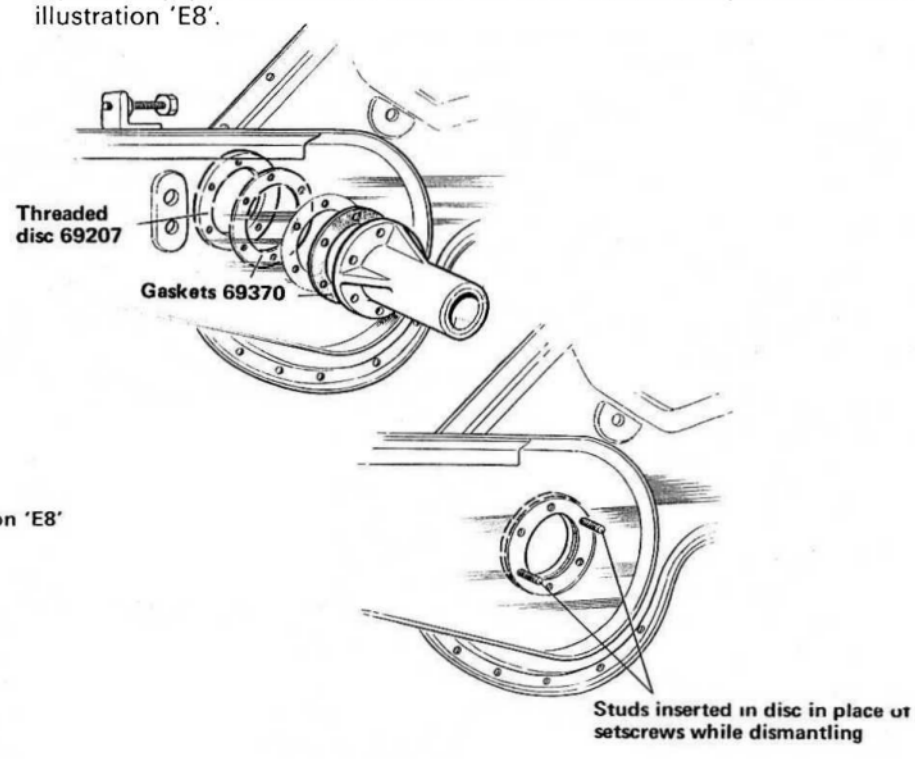


Illustration 'E8'

The oilseal (160) and the bushes (161) can then be removed from each housing, as shown in illustration 'E9', using special tool S.100 and a suitable press.

N.B. Oilseal and bushes are pushed out in one operation.

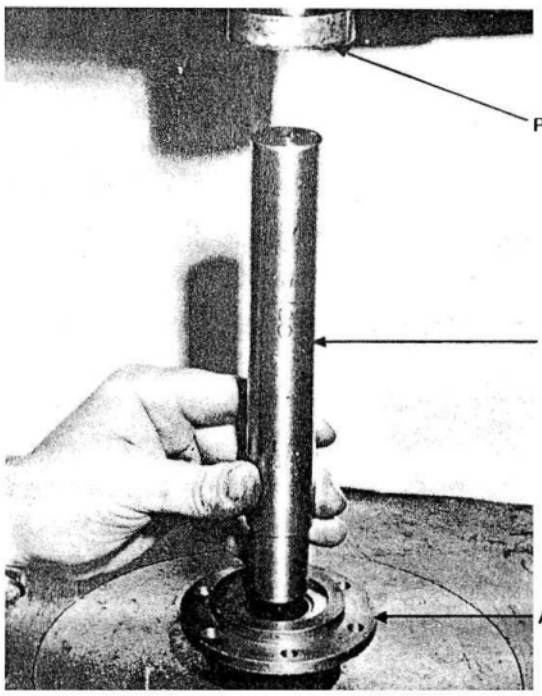


Illustration 'E9'

16. Remove bearing (213) and oilseal (212) from their location in the chaincase, using a $1\frac{15}{16}$ in dia drift.

Check all individual parts for wear, with particular regard to bearings, thrust washers, shaft location holes and the chain drive. Should any parts appear excessively worn they should be replaced otherwise the machine will not function correctly when reassembled. Always use new oilseals on assembly.

TO ASSEMBLE CHAINCASE

The following assembly instructions refer to illustration 'E1' page 34 (unless otherwise stated).

1. Press oilseal (212) (with lip facing inwards) and bearing (213) into their location in the chaincase, using a $1\frac{15}{16}$ in dia drift and a suitable press.

2. **To assemble/fit rotor bearing housing(s)**
   Clean the rotor bearing housing (102) ensuring that the bearing location is free from dirt and grease. Position needle roller bearing (169) in the housing, and using special tool S.101 (complete with its collar) press the bearing into its location, as shown in illustration 'E10'.

   The oilseals (167) should be fitted back to back, as shown in illustration 'E11', so that the inner seal lip faces inwards and prevents oil leakage from the chaincase, and the outer seal lip faces outwards and prevents the entry of dirt.

N.B. These seals should be pushed into their location, using special tool S.102 and a suitable press, as shown in illustration 'E12'.

Assemble the rotor bearing housings (102) and depth skid brackets, with a gasket in between each part, as shown in illustration 'E6'. Secure assemblies to the chaincase and backplate using the setscrews and discs.

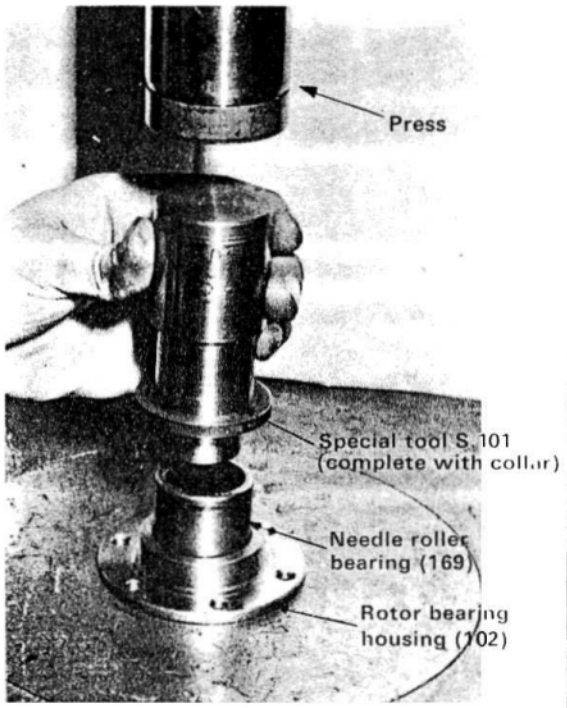
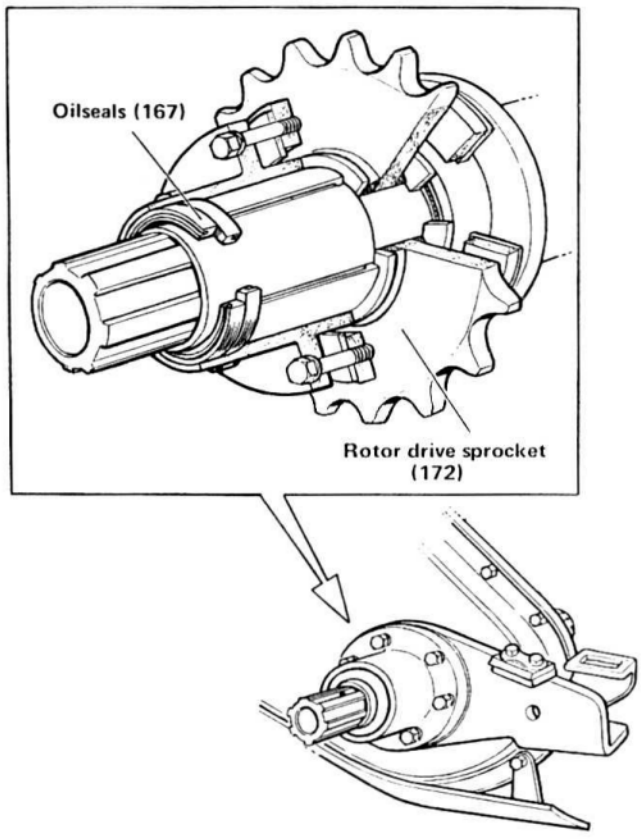


Illustration 'E10'

Illustration 'E12'

Illustration 'E11'



3. **To assemble/fit axle bearing housing(s)**
Press bushes (161) into axle bearing housing (103) inserting one from each end, using special tool S.100 (complete with its collar) as shown in illustration 'E13'.

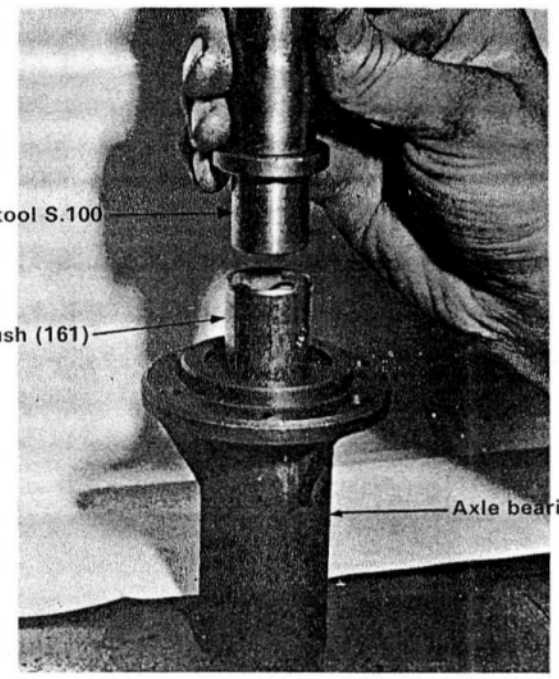


Illustration 'E13'

Fit the axle bearing housing (103) to the chaincase and the backplate as shown in illustration 'E8', using the setscrews and discs, with a gasket between each part.

4. Locate key (163) in the keyway in axle shaft (162) and slide the bull wheel gear (164) along the shaft and press onto the key.

5. Fit spacers (165) onto the axle shaft, on each side of the bull wheel.

6. Position the axle shaft through the backplate, such that the thicker 'boss' on the bull wheel gear is towards the backplate and locate in the axle bearing housing (103).

7. Place thrust washer (190) onto the top drive sprocket spindle (193).

8. Locate the drive chain (171) on the rotor drive sprocket (172) and top drive sprocket (191), and fit the assembly to the backplate.

N.B. When fitting the rotor drive sprocket through the rotor bearing housing, special tool S.104 should be positioned over the end of the splined shaft to protect the oilseals (167) in the bearing housing. If this special tool is not used the seals will be damaged as the splines pass through.

The top drive sprocket must be positioned on the drive sprocket spindle, and the rotor drive sprocket in the rotor bearing housing such that they will slide into their locations simultaneously.

9. Check that the chain drive moves freely, and that the top drive sprocket and the rotor drive sprocket are seated correctly.

10. Position thrust washer (190) on the drive sprocket spindle (193) against the front face of the top drive sprocket (191). Secure in position using thick grease. This will prevent the thrust washer from dropping into the chain-case during assembly.

11. Secure a new gasket to the gearbox, with a smear of Red Hermatite, on both sides.

12. Fit the gearbox to the backplate using the crosshead screws (E14–241).

N.B. Use thick grease to secure thrust washer (E14–223) to the final drive pinion (E14–224). This will prevent it from falling into the chaincase during assembly.

13. Fit the three countersunk head screws (E14–240) through the backplate to secure the gearbox.

N.B. The use of Loctite stud lock is recommended when fitting these screws. If Loctite is not available the screws should be secured by burring the metal of the backplate into the slot on the head of each screw, using a small punch.

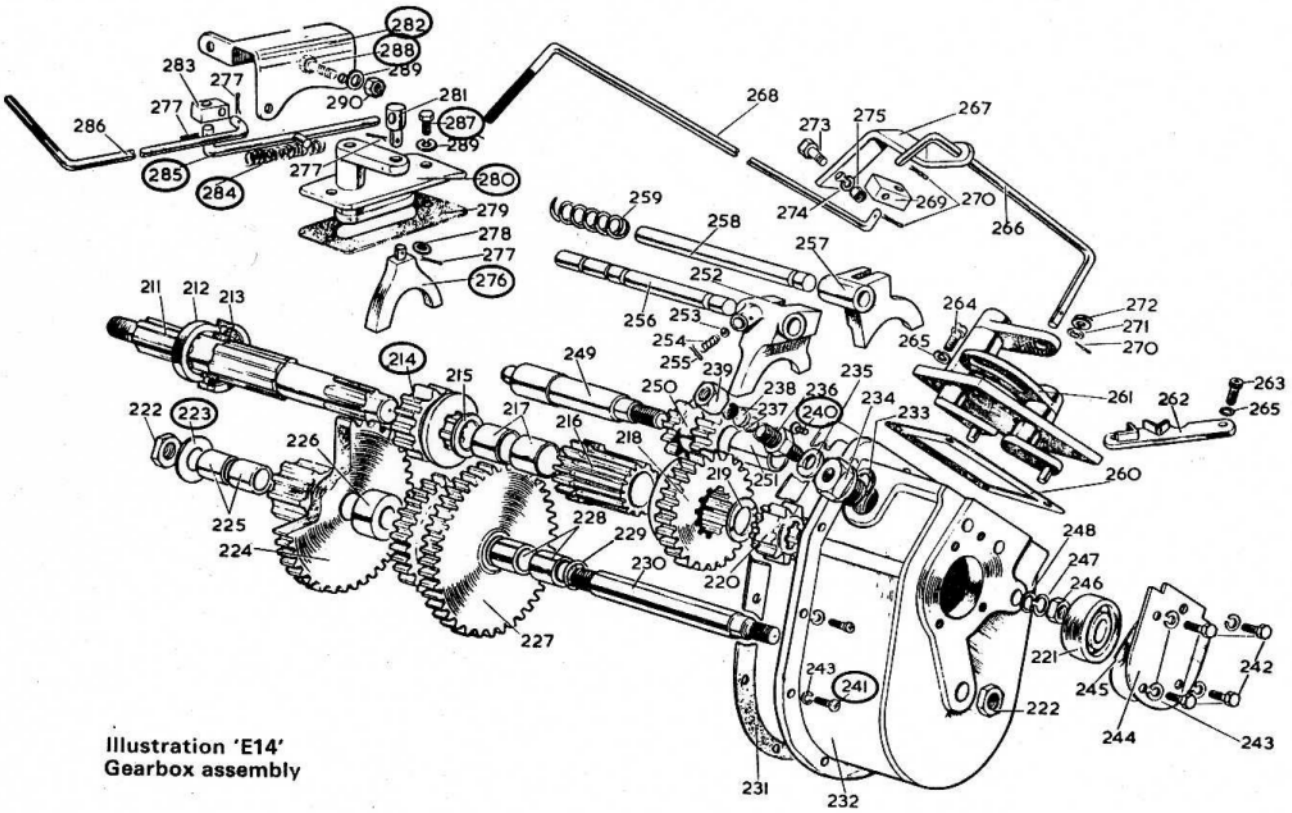


Illustration 'E14'
Gearbox assembly

14. Fit the chain tensioner (125) using bolt (127) leaving the nut off, so that the bolt will pass through the chaincase on assembly.

15. Secure a new gasket, to the chaincase, with a smear of Red Hermatite on both sides. Slacken the chain adjuster screw (123).

16. Position the chaincase, as shown in illustration 'E15', such that the wheel axle passes through the axle bearing housing (103).

N.B. To prevent damage to the oilseals (167) in the rotor bearing housing when the splines of the rotor drive sprocket (172) pass through them, special tool S.104 should be positioned over the end of the splined shaft.

17. Slide the chaincase up to the backplate, checking that the chain tensioner (125) does not become trapped between the chaincase and backplate.

18. Fit nut (128) to the chain tensioner pivot bolt (127).

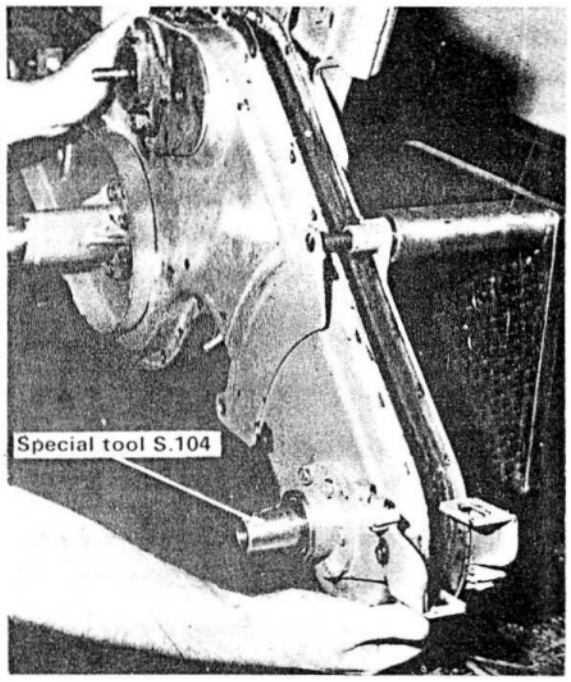


Illustration 'E15'

19. Position spacer (130) between the depth skid brackets and secure using bolt (129).

20. Fit all the nuts and bolts around the perimeter of the chaincase and tighten to 8·5 lb/ft (1·2 kg/m) torque.

21. Fit setscrew (197) to the drive sprocket spindle, and locknut (222) to the gearbox intermediate shaft, shown in Diagram 'E3'.

22. Fit the chaincase skid (133) to the bottom of the chaincase below the rotor drive sprocket (172), using setscrews (134).

23. Position the rotor selector control assembly (E14–280) on top of the chaincase ensuring that the selector fork (E14–276) locates correctly in the rotor selector gear (E14–214). Secure the assembly using setscrews (E14–287).

24. Secure selector gate (E14–282) using setscrews (E14–288) such that the selector rod (E14–285) is held against the spring (E14–284).

25. **To fit oilseal (160) to axle bearing housings**
To prevent damage to the oilseal when pushed over the machined flat on the axle shaft, metal shim should be wrapped around the shaft, as shown in Diagram 'E16'.

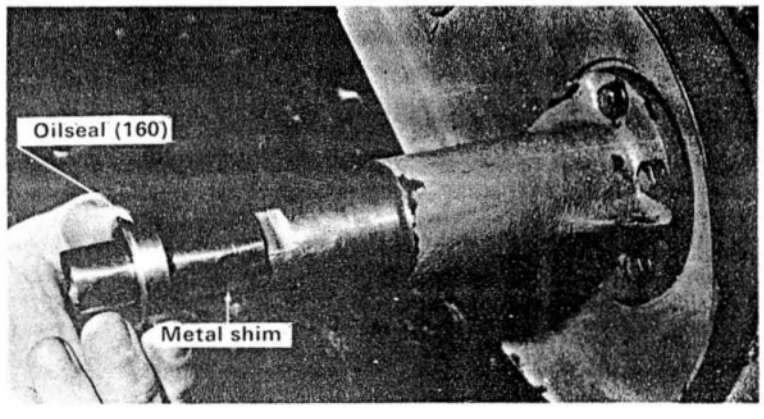
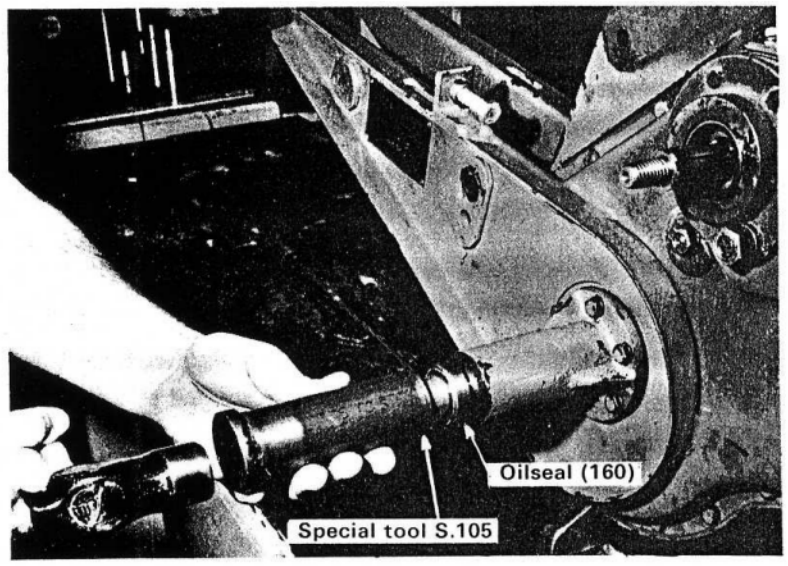


Illustration 'E16'

Tap seal into position using special tool S.105, as shown in illustration 'E17'.

Illustration 'E17'



26. Fit the transmission pulley (Section F).
    The chaincase should now be removed from the stand (special tool S.107).

27. Fit spacer (120) between the front engine support arms and secure using bolt (119).

28. Fit the wheels and hubs.

29. Assemble the rotor unit (Section D).

30. Refit handlebars and controls.

31. Fit engine baseplate (69) loosely, using nut (83).

32. Fit engine (Section B).

    Adjustments should be made as described under 'Adjustments' in Clutch Section C, Rotor Section D and Gearbox Section F.

33. Fill engine with fresh oil and petrol (see Engine Manual).

34. Fill the transmission with $1\frac{1}{2}$ pints (0·8 litres) of S.A.E. 90 gear oil (see Adjustments Section G).

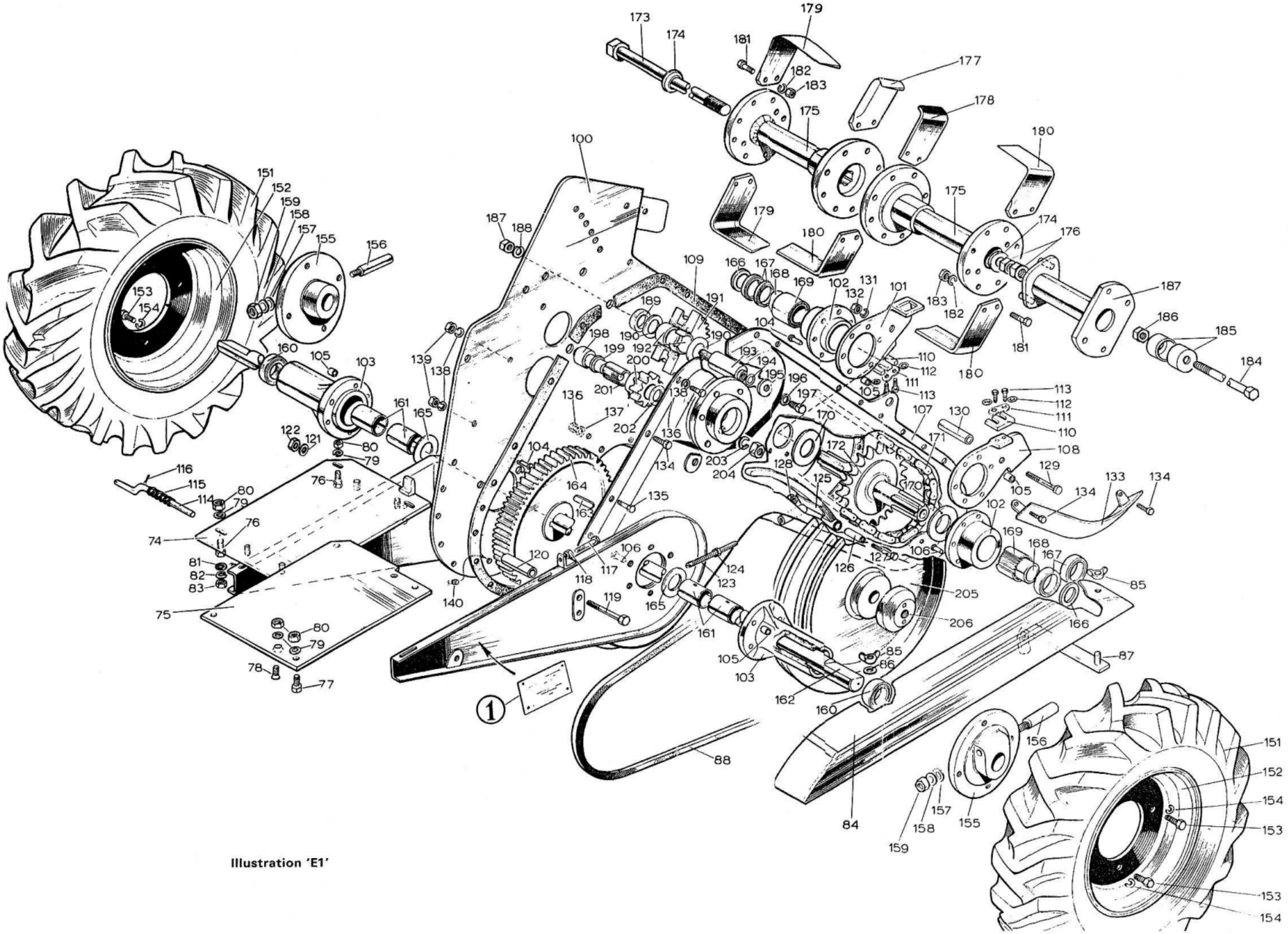


Illustration 'E1'

WHEELS AND WHEEL HUBS

N.B. Before removing the wheels, support the machine with a jack, or on blocks, such that it will not fall when the wheels are removed.

DISMANTLING PROCEDURE

To remove the wheels from the machine remove the four $\frac{3}{8}$ in × $\frac{3}{4}$ in long set screws located in the centre of the wheel rim, which retains the wheel in position on the spigot of the wheel hub. The wheel hubs which are mounted on the axle are secured in position by a cotter pin. To remove the hub first slacken the nut securing the cotter pin in position and tap to loosen the cotter pin. Remove the nut, together with the flat and spring washers. Turn the hub so that the thread of the cotter pin is in the vertical position, with the aid of a $\frac{1}{4}$ in dia brass drift drive the cotter pin out through the wheel hub, taking care not to damage the thread . The hubs may now be withdrawn from the wheel axle

ASSEMBLY PROCEDURE

Before assembling the wheel hubs on to the wheel axles ensure that the four $\frac{3}{8}$ in UNC threaded holes and adjacent parts of both axles and hubs are free from dirt and grease. The wheel hub is positioned on to the axle with the spigot by which the wheel rim is located, facing outwards, and is then mounted flush to the end of the axle and held in position by the cotter pin.

When fitting make sure that the taper of the cotter pin is in line with the flat machined face on the axle, and the pin may then be tapped into position. Place the $\frac{3}{8}$ in UNF nut complete with spring washer on to the thread of the cotter pin. Tighten the nut and tap the pin to draw it firmly into position, then retighten the nut to 33·8 lb/ft torque.

The wheel rims may then be located on to the spigots of the wheel hubs, and the four setscrews inserted and tightened up evenly to 31 lb/ft torque.

HOWARD 300/350—GEARBOX F

CONTENTS:

SERVICE BULLETINS APPERTAINING TO THIS SECTION ARE:

Bulletin No.	*Date*

TOOLS REQUIRED WHEN REMOVING/DISMANTLING/ASSEMBLING/ FITTING GEARBOX

No. off	
1	$\frac{7}{16}$ in AF open ended spanner
2	$\frac{9}{16}$ in AF open ended spanner
1	Pair 6 in engineers pliers
1	Copper/rawhide hammer
1	Small punch
1	Large screwdriver
1	Large Philips screwdriver
1	$\frac{7}{16}$ in allen key
1	Set of feeler gauges
1	$\frac{1}{4}$ in dia soft brass drift
1	$\frac{1}{2}$ in dia soft brass drift
1	$1\frac{3}{8}$ in dia soft brass drift

SPECIAL EQUIPMENT

This special equipment is described under 'Specification' Section 'A'.

Special tools: S.103
S.106
S.107

Red Hermatite gasket sealing compound.

F GEARBOX—HOWARD 300/350

DESCRIPTION

Input drive is via a vee belt to the large alloy transmission pulley (E1-205) located on the splined drive shaft (F1-211) which protrudes through the chaincase from the gearbox.

The gearbox embodies drive, reverse and intermediate shaft assemblies. It incorporates two forward speeds and one reverse, which are controlled by gear selectors and rods from the handlebars. The reverse gear is spring loaded as a safety precaution, and must be held against the spring to engage.

TO REMOVE GEARBOX FROM MACHINE

(Illustration 'F1' can be found on page 46).

1. Drain the oil from the transmission (Section G).

2. Remove the engine (Section B).

3. Remove the split pin from the lower control rod (F1-266) and withdraw the rod from the gearbox cover selectors.

4. Remove wheels and hubs (Section E).

5. Remove the handlebars.
   To make removal of the gearbox easier it is recommended that the rotor unit (Section D) and bolt (E1-119), are first removed so that the transmission assembly may be supported on a stand (special tool S.107 see Specifications Section A;

6. **To remove the transmission pulley**
   To remove the special nut (206) shown in Diagram 'F2', a peg spanner (special tool S.106) will be required, and should be turned anti-clockwise to remove the nut.

7. Remove setscrews (F1-288) from the selector gate (F1-282).

8. Remove setscrews (F1-287) and withdraw the rotor selector assembly (F1-280) complete with selector rod and gate.

N.B. Once the selector assembly has been removed, cover the hole so that nothing will fall into the chaincase.

9. Remove the crosshead screws (241) and setscrews (135) shown in Diagram 'F3', from around the perimeter of the gearbox.

10. Remove the three countersunk head screws and the locknut, shown in Diagram 'F4' from the chaincase side of the backplate.

11. Turn the transmission on to its side with the gearbox facing downwards. This is so that thrust washer (F1-223) does not fall into the chaincase while removing the gearbox.

12. Tap the splined shaft (F1-211) out of the bearing as shown in Diagram 'F5' using a soft headed hammer.

N.B. The gearbox should be supported by hand until it comes away from the backplate.

The gearbox may now be placed on a bench for complete dismantling.

Illustration 'F2'

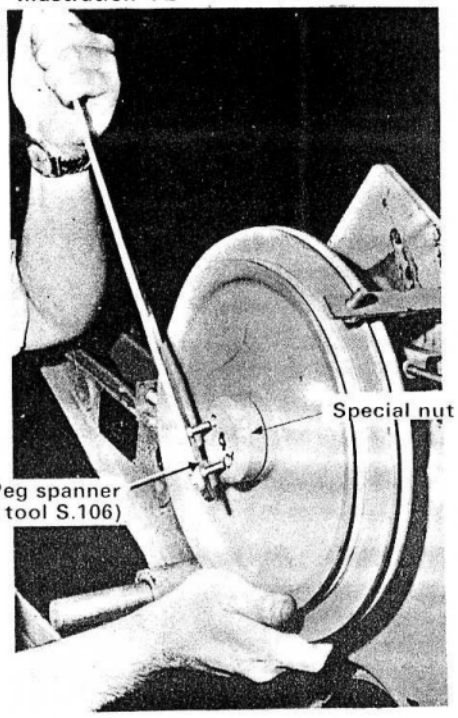
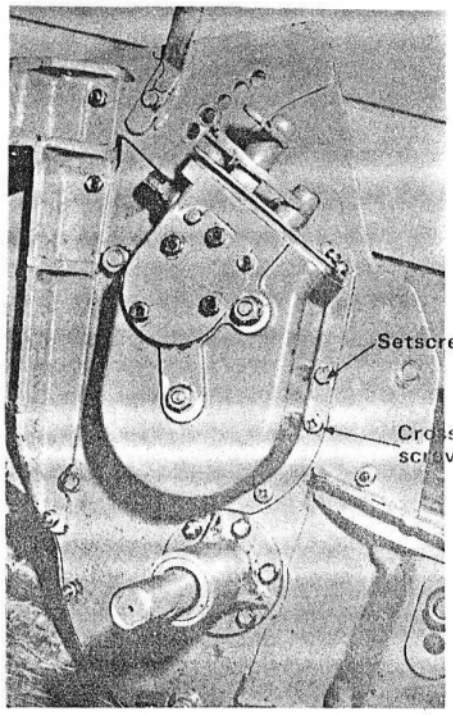


Illustration 'F3'



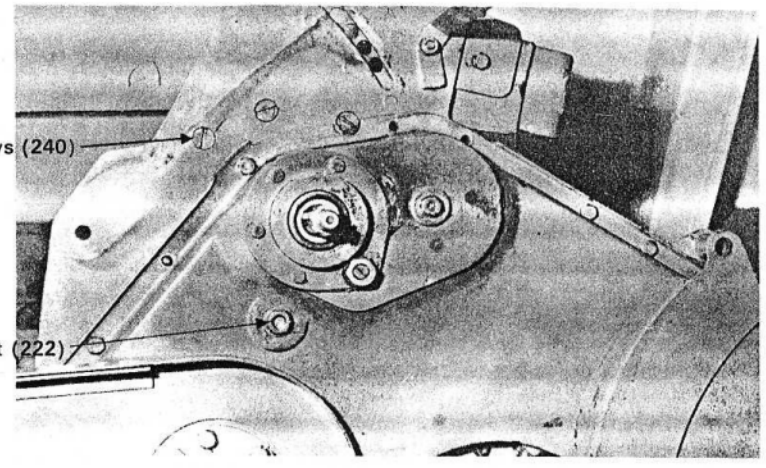
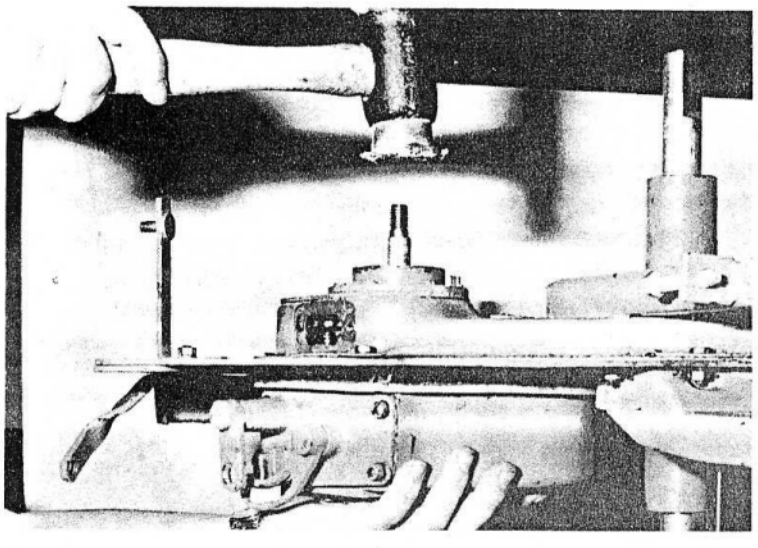


Illustration 'F4'

Illustration 'F5'



F GEARBOX—HOWARD 300/350

SEQUENCE OF DISMANTLING GEARBOX

The following dismantling instructions refer to Diagram 'F1' (unless otherwise stated).

1. Remove the gearbox cover and selectors (261).

2. Remove the rotor selector gear (214).

3. Remove thrust washer (223) and final drive gear (224) from the intermediate shaft (230).

N.B. If the bushes (225) are to be removed, special tool S.103 should be used for both removal and fitting.

4. Remove setscrews (242) from the bearing and slide bar cover (244) and remove the cover from the gearbox.

5. Push the drive shaft (211) from bearing (221) as shown in Diagram 'F6' using a $\frac{1}{2}$ in dia drift and a suitable press.

N.B. If when pushing out the shaft the bearing is also pressed from its location, it should be removed from the shaft using a suitable '3' legged universal 'puller'.

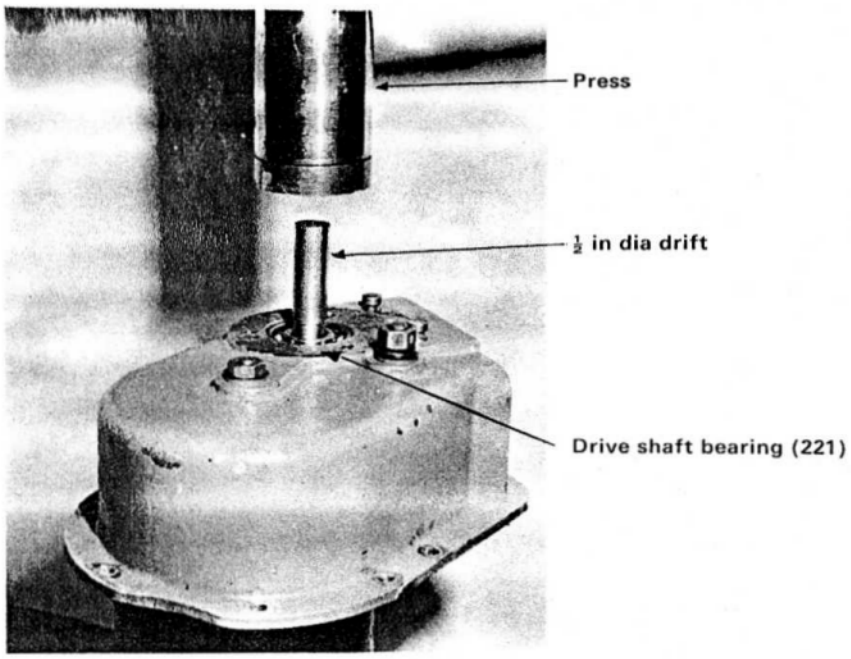


Illustration 'F6'

6. Remove the drive gear (216) and thrust washer (215).

7. Remove the travel selector slide bar (256) together with the drive shaft gear 27T (218), thrust washer (219) and drive shaft gear 13T (220).

N.B. It may be necessary to tap the protruding travel selector slide bar from its location, as shown in illustration 'F7' using a $\frac{1}{4}$ in dia drift.

8. Remove the gear spacer (226) and cluster gear (227).

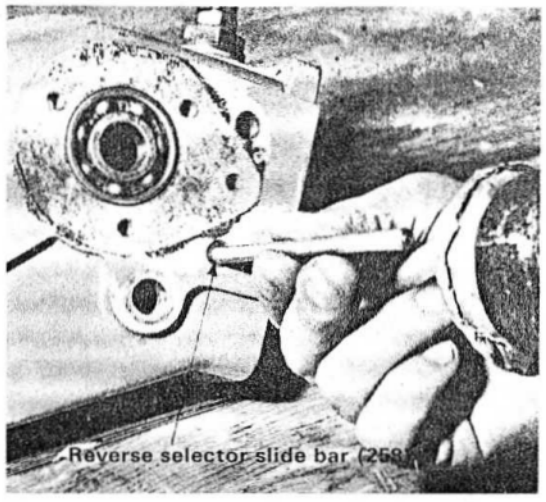
N.B. If the bushes (228) are to be removed, special tool S.103 should be used for both removal and fitting.

9. Remove locknut (222) and withdraw the intermediate shaft (230).

10. Remove nut (246) and withdraw the reverse spindle (249) together with reverse gear (250).

Illustration 'F7'

Illustration 'F8'



11. Remove the reverse selector slide bar (258) complete with the reverse selector (257) and spring (259).

N.B. It may be necessary to tap the protruding reverse selector slide bar from its location, as shown in illustration 'F8' using a $\frac{1}{4}$ in dia drift.

12. Press bearing (221) from its location in the gearbox as shown in illustration 'F9' using a $1\frac{3}{8}$ in dia drift.

Examine all the gears and replace any that appear excessively worn, (i.e. hooked teeth etc.). Particular attention should be given to the condition of the brass reverse selector (257) and the reverse selector mounted on the gearbox cover. Wear in these parts is accelerated due to the reverse gear being held against a spring; and excessive wear will make selection of reverse gear difficult. Check the condition of bearing (221) and replace if necessary. Wear in this bearing will increase the loads on the gear teeth and will also make the gearbox noisy.

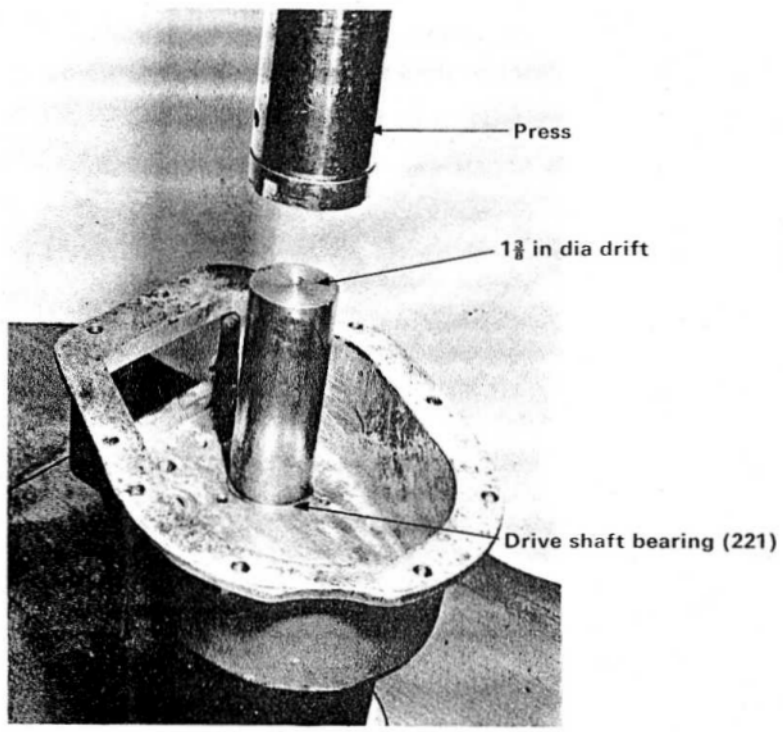


Illustration 'F9'

F GEARBOX—HOWARD 300/350

SEQUENCE OF ASSEMBLING GEARBOX

The following assembly instructions refer to illustration 'F1' (unless otherwise stated).

1. Press bearing (221) into gearbox, as shown in illustration 'F10' using a $1\frac{3}{8}$ in dia drift.

2. Press reverse gear selector slide bar (258) complete with reverse selector (257) and spring (259) into its location in the gearbox as shown in illustration 'F11'.

Illustration 'F10'

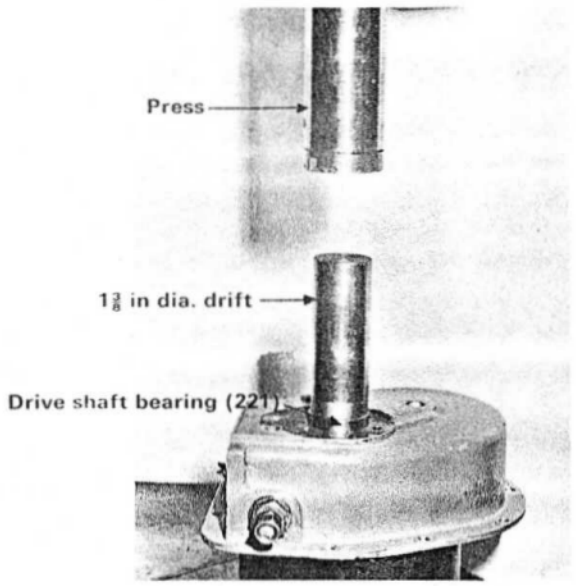
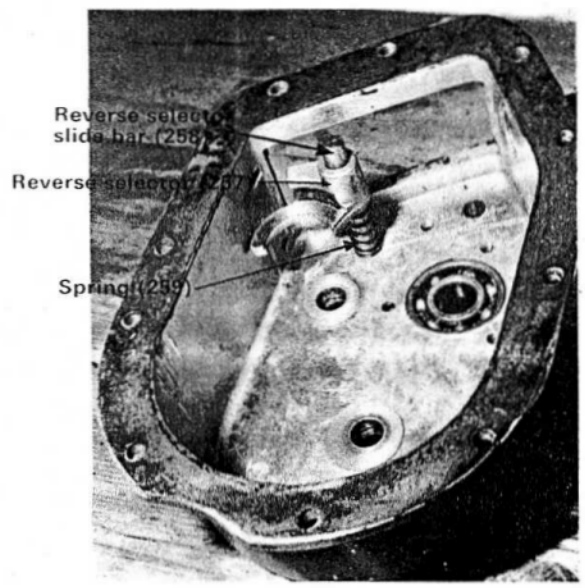


Illustration 'F11'



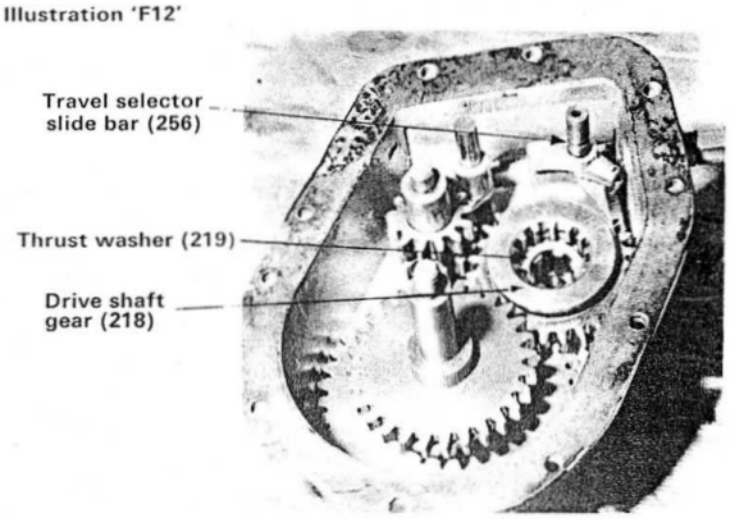
3. Fit the reverse spindle (249) complete with reverse gear (250) ensuring that the reverse selector (257) locates correctly in the reverse gear. Secure the spindle using nut (246).

4. Fit the intermediate shaft (230) and secure using locknut (222).

5. Fit cluster gear (227) onto the intermediate shaft.

6. Press the travel selector slide bar (256) complete with drive shaft gear 13T (220), thrust washer (219) and drive shaft gear 27T (218), into its location in the gearbox as shown in illustration 'F12'.

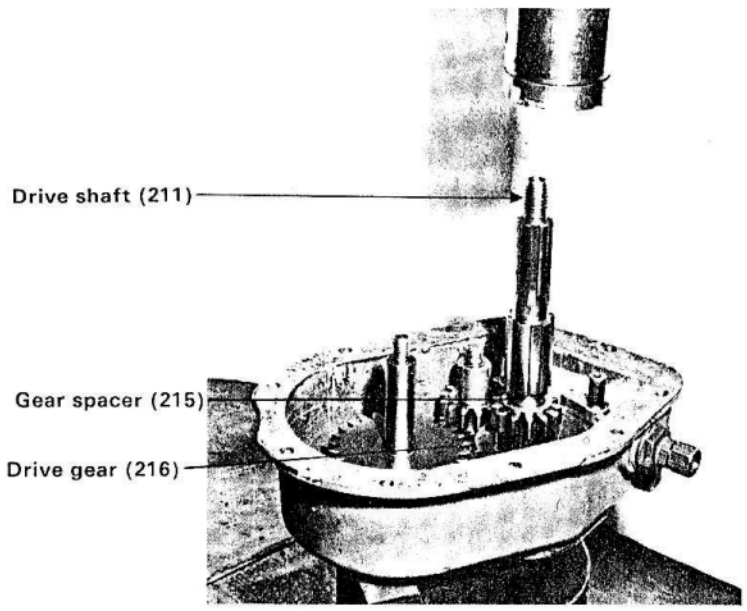
Illustration 'F12'



7. Fit the bearing and slide bar cover (244) with a gasket and secure to the gearbox using setscrews (242).

8. Position the drive shaft (211) complete with gear spacer (215) and drive gear (216), through the drive shaft gears and press into bearing (221) as shown in illustration 'F13'.

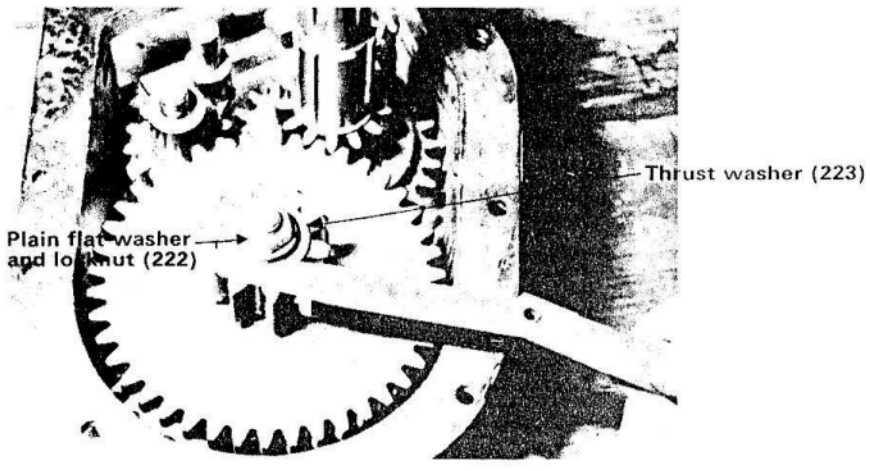
Illustration 'F13'



9. Place gear spacer (226) on cluster gear (227) and fit the final drive gear (224) onto the intermediate shaft (230) with thrust washer (223) located on top.

N.B. The final drive gear (224) should be approximately 0·005 in from the top of the intermediate shaft (with the thrust washer in position). This should be checked, as shown in illustration 'F14', with the aid of a $\frac{3}{8}$ in dia plain flat washer, which should be placed over the thread on the intermediate shaft and secured against the shoulder using locknut (222). The gap between the plain washer and the thrust washer should then be measured using a feeler gauge. If this gap is incorrect then 0·010 in and 0·015 in shims should be used as follows:
Remove the final drive gear and place the required number of shims onto the intermediate shaft against the brass spacer (266). Replace the final drive gear and thrust washer, and recheck the height of the gear to the shaft.

Illustration 'F14'



10. Fit the gearbox cover selectors (261) using setscrews (264). Make sure that the pegs on the cover plate selectors locate correctly in the brass, travel and reverse, selectors inside the gearbox.

    Check that all gears are free running, and that all gear ratios can be engaged.

11. Fit the rotor selector gear (214) onto the drive shaft (211).

TO REFIT GEARBOX TO MACHINE

N.B. Thick grease should be used to secure the brass thrust washer (F1–223) to the final drive gear, to prevent it from falling into the chaincase when fitting the gearbox.

1. Secure a new gasket, to the gearbox, with a smear of Red Hermatite on both sides.

2. With the transmission laying on its side, pass the splined drive shaft (F1–211) up through the bearing, located in the chaincase, and gently tap home.

3. Fit locknut (222) to the intermediate shaft (F1–230) and secure the top of the gearbox using the three countersunk head screws (240) shown in illustration 'F4'.

N.B. When fitting these screws the use of 'Loctite' stud lock is recommended. If 'Loctite' is not available the screws should be secured by burring the back-plate metal into the slot on the head of each screw, with the aid of a small punch.

4. Fit setscrews (241) and (135) to the perimeter of the gearbox as shown in illustration 'F3'.

5. Fit the rotor selector assembly (F1–230) using setscrews (F1–287) ensuring correct location of the selector (F1–276) in the rotor drive gear (F1–214).

6. Secure rotor selector gate (F1–282) using setscrews (F1–288) such that the selector rod (F1–285) is held against the spring (F1–284).

7. **To fit transmission pulley**
   Refit the transmission pulley (E1–205) and secure using nut (E1–206). Tighten nut with the aid of special peg spanner S.106.

   The chaincase may now be removed from the stand (special tool S.107), and refit spacer (E1–120) between front support arm, and secure using bolt (E1–119).

8. Fit rotor assembly (Section D).

9. Fit wheels and hubs (Section E).

10. Fit handlebars and controls.

11. Fit engine (Section B).

12. Position lower control rod (F1–266) through the cover plate selectors (F1–261) and secure using split pin (F1–270). Adjustments should be made as described under 'Adjustments' at the end of this section and in Clutch Section 'C'.

13. Refill the transmission with 1½ pints (0·8 litres) of good quality S.A.E. 90 gear oil (Section G).

ADJUSTMENTS

GEARBOX SELECTOR GATE (F1-262)

The gearbox cover, and the attached selectors are situated on top of the gearbox. The selector gate is located on the cover plate by two capscrews, and prevents changing from forward to reverse gear without going into neutral first.

To adjust the selector gate loosen the two capscrews (F1-263) and with the selectors in the neutral position, centralise the gate and tighten the capscrews.

Check that all gears are easily engaged. The gear lever is pushed *forward* for *slow*, pulled *back* for *fast* and neutral is midway between. For reverse put the lever into the neutral position, then turn clockwise and hold in position against the spring as shown in illustration 'F15'.

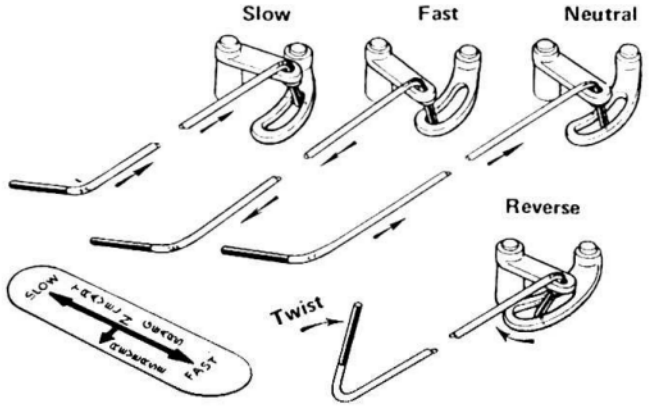


Illustration 'F15'

FAULT FINDING CHART

Fault	*Check*
a. Difficulty in engaging gears	Clutch (see fault finding chart Section 'C').
	Adjustment of gear selector gate (F1-262) (see Adjustments).
	That the 27T drive shaft gear (F1-218) moves freely on the splined intermediate gear (F1-216).
	That the travel selector (F1-252) is positioned correctly in the guideway of the 27T drive shaft gear (F1-218).
	Whether the spring (F1-254) in the selector (F1-252) is broken.
	If the gear selector rod (F1-268) requires lubricating.
	If gear selector rod (F1-268) is bent.
	If the selector rod (F1-266) is positioned correctly in both selector arms (F1-261).
	Whether the reverse selector spring (F1-256) is broken.

F GEARBOX—HOWARD 300/350

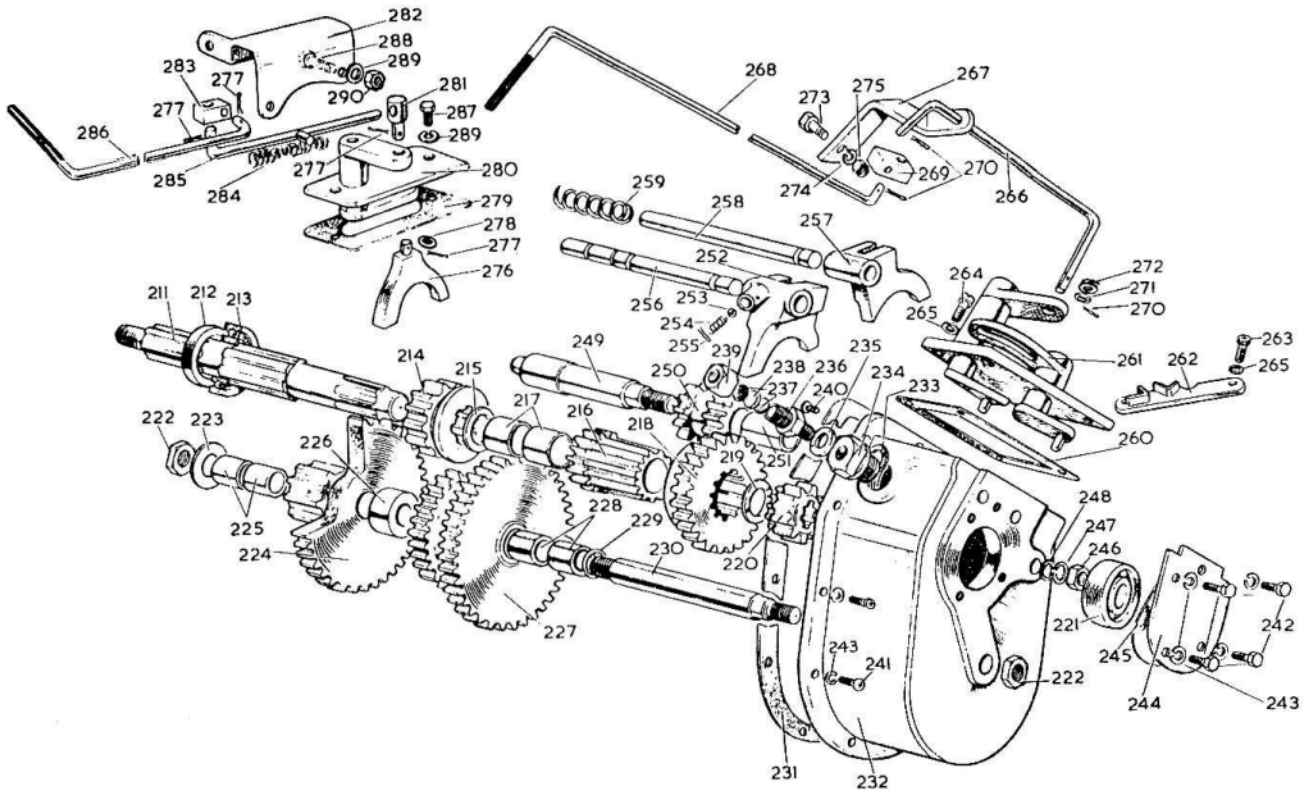


Illustration 'F1'
Gearbox Assembly

Keep this page open when referring to the instructions in Section F

b. Difficulty in Engaging rotor	Whether the rotor selector spring (F1–284) is broken.
	Rotor selector rod (F1–286) requires lubricating.
	That the rotor selector rod (F1–286) is not bent.
	If rotor selector rod is positioned correctly in rotor selector arm (F1–280).
	That the rotor selector gear (F1–214) slides freely on the splined drive shaft (F1–211).
	If rotor selector (F1–276) is positioned correctly in the guideway of the rotor selector gear (F1–214).
c. Oil leaks.	Whether the drain plug (E1–140) is loose.
	Tightness of gearbox retaining screws.
	If gasket (F1–231) is damaged if so replace.
	That gearbox breather is clear. Failure to keep clear will result in a pressure build up inside the gearbox, causing oil leaks.

G LUBRICATION & MAINTENANCE

LUBRICATION AND MAINTENANCE

Before oiling, adjusting or servicing the machine **STOP THE ENGINE.**

OILS

Use only good quality oils as listed in 'Specification' Section A, under 'Recommended Lubricants'.

EVERY 10 HOURS OR DAILY

1. Check the engine oil level (see Engine Handbook).
2. Check the air cleaner (see Engine Section 'B').
3. Check the tightness of the blade bolts, and straighten any bent blades.
4. Watch for signs of clutch slip; adjust the clutch if necessary (see Adjustments Clutch Section 'C').

EVERY 25 HOURS OR WEEKLY (Additional to 10 hour maintenance)

1. Service the engine (see Engine Handbook).
2. Change the engine oil (see Engine Handbook).
3. Check the chaincase oil level (see Adjustments at the end of this section).
4. Check the drive chain tension and adjust if necessary (see Adjustments Rotor Section 'D').
5. Check the drive vee belt alignment and tension (see Adjustments Clutch Section 'C').
6. Lightly oil the throttle and clutch cables, the gear clutch and rotor control pivots, handlebar pivot and slide, shield securing pins, depth control adjustment, engine adjuster bolts, wheel hub cotter pins, and all pivot points and control rod guides.
7. Tighten all nuts and bolts.
8. Check the clutch adjustment and reset if necessary (see Adjustments Clutch Section 'C').
9. Check the tyre pressures are correct at 20 psi (1·4 kg/sq. cm).
10. Adjust weed cutter blades (see Adjustments Rotor Section 'D').

EVERY 250 HOURS OR 3 MONTHLY (Additional to 10 and 25 hour maintenance)

1. Clean the gearbox and chaincase (see Adjustments at the end of this section).
2. Check air cleaner and replace the element if of the paper type (see Air Cleaner Engine Section 'B').
3. Grease the inner clutch cone splines with lithium base grease.

CLEANING THE GEARBOX AND CHAINCASE

After 250 hours of work the gearbox and chaincase should be cleaned out as follows:

To drain the transmission unscrew the drain plug positioned at the bottom righ-hand side of the backplate. The transmission should be drained immediately after a period of running so that any sediment will be carried out in the oil. Replace the drain plug and refill the gearbox with 1½ pints (0·8 litres) of flushing oil through the breather on the rear of the gearbox. Run the machine for about 3 minutes while holding the rotor well clear of the ground. Switch off, drain the flushing oil and replace the drain plug.

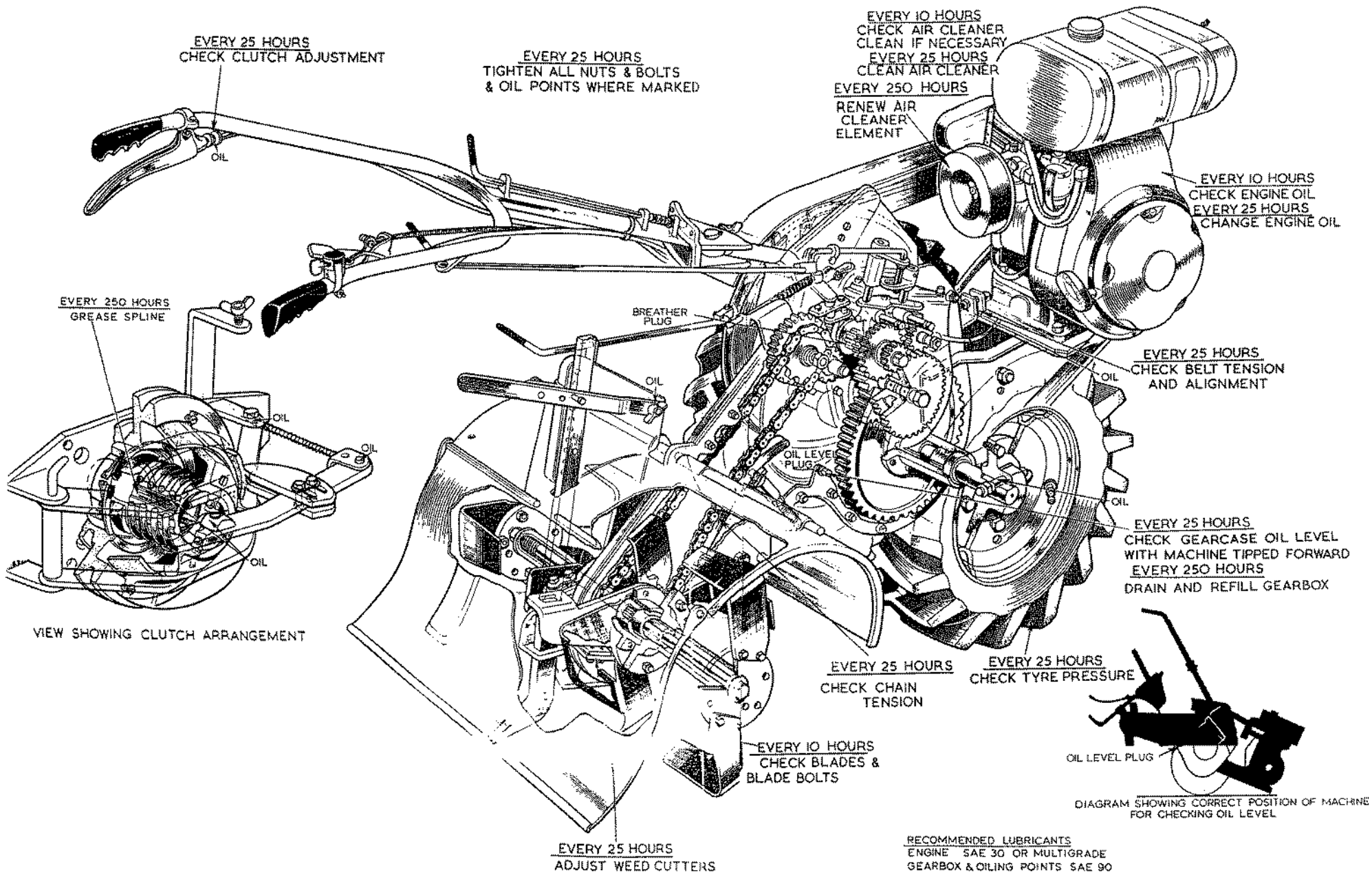
Fill the gearbox with 1½ pints (0·8 litres) of good quality S.A.E. 90 gear oil, clean and replace the breather.

CHAINCASE OIL LEVEL

To check the oil level in the transmission, tip the machine forward onto the engine bearers. Remove the oil level screw from the right hand side of the backplate. Oil should just appear over the threads, top up through the gearbox if necessary, but do not overfill.

OPEN OUT →

LUBRICATION AND MAINTENANCE CHART



VIEW SHOWING CLUTCH ARRANGEMENT

DIAGRAM SHOWING CORRECT POSITION OF MACHINE FOR CHECKING OIL LEVEL

RECOMMENDED LUBRICANTS
ENGINE SAE 30 OR MULTIGRADE
GEARBOX & OILING POINTS SAE 90