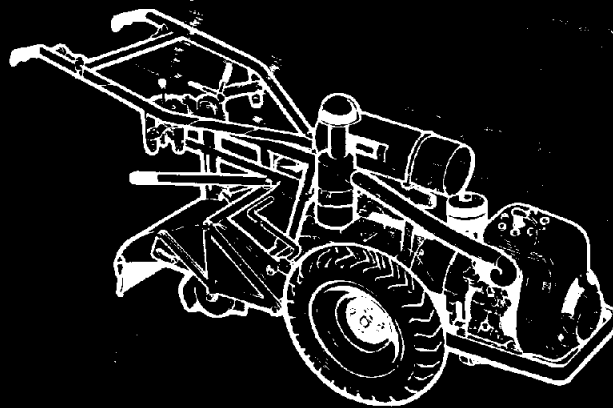


Howard*
Rotavator* Gem*
Operating Instructions



GENERAL SAFETY PRECAUTIONS

1. Read and familiarise yourself with the operating instruction book.
2. Do not allow children to operate the machine. Do not allow adults to operate the machine without proper instructions.
3. Clear the work area of objects which might be picked up and thrown.
4. Before attempting to start the machine ensure the gear lever is in neutral and the rotor drive disengaged.
5. Never tamper with the reverse gear mechanism, this is a safety device.
6. Disengage the rotor drive before reversing or turning the machine.
7. Work up and down the face of steep slopes, never across them.
8. Handle petrol with care –
Use an approved petrol container.
Never remove the cap of the fuel tank or add petrol to a running or hot engine, or fill the tank indoors. Wipe up spilled petrol.
9. Open doors if the engine is run in the garage – exhaust fumes are dangerous.
10. Keep all nuts, bolts and screws tight and be sure that the equipment is regularly lubricated to keep it in a safe working condition.
11. Keep all safety guards in place.
12. Never touch the rotor with the engine running – switch off first.
13. Always wear substantial footwear to provide as much protection as possible.
14. The warning transfer (part number 27409) illustrated below should always be in position on your machine. If, for any reason it is missing a replacement will be supplied free of charge.

WARNING

**beware of rotating
blades see there
is no one in the
direction of driving**

Howard*

Rotavator* Gem*

Operating Instructions



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The Howard Gem is THE heavy duty hand-controlled Rotavator for growers, farmers and contractors.

From seedbed making to land reclaiming, catch cropping to weed control, mixing-in manure to breaking up pasture, the work power and engineering quality of the Gem are unequalled.

The Gem has three forward gears providing the right speed for any type of work or soil condition. A reverse gear gives

ease of handling in confined areas; adjustable handlebars, up or down, side to side, aid operator comfort and flexibility of control.

Simple construction and a proven design keep maintenance to a minimum.

Optional attachments include a furrower, depth control wheel and front-end weights.

WORKING THE MACHINE

Start the engine according to the engine instruction book. Lift the clutch lever and engage the required gear. **DO NOT FORCE THE GEARS INTO MESH.** If they do not immediately engage, release the clutch lever momentarily.

The slight noise which may be heard when the clutch is engaged is due to the positive action of the twin clutch plates.

When in a position to begin Rotavating, lift the clutch lever again, and move the rotor engagement lever to the "IN" position. Increase the engine speed and gently release the clutch, allowing the machine to pull itself into the work.

The rotor engagement lever also operates the differential lock. The lever must therefore be put into the "OUT" position for turning.

The depth is controlled by pressing the depth control lever to the right. This releases the skid in the socket, allowing it to be repositioned as required. The skid itself has two alternative holes, the lower one of which permits a greater depth to be obtained.

Choose the depth to suit the crop being planted. If this is deeper than can be obtained in one pass without the engine labouring, several passes should be made at progressively increasing depths.

First gear should be used for heavy work, and where a fine tilth is required. Second gear should be used for average conditions, and top gear for light hoeing and road work.

Where a coarse tilth is required, the rotor shield should be raised as high as possible with the trailing board folded back. The rotor should always be disengaged when reversing as well as when turning at headlands.

To stop the machine, raise the clutch lever, and move the gear lever to the centre (neutral) position. Move the rotor engagement lever to the "OUT" position and then release the clutch.

REVERSING

To reverse, pull up the clutch lever, move the gear lever to Reverse (this simultaneously operates the safety interlock) and release the clutch lever. No movement occurs until the clutch lever is pushed down. Removal of pressure automatically stops the machine. To disengage levers, pull up the clutch lever and move the lever to neutral.

NEVER, UNDER ANY CIRCUMSTANCES, TAMPER WITH THE REVERSE GEAR LINKAGE. THE INTER-LOCK MECHANISM IS A SAFETY DEVICE AND MUST NOT BE INTERFERED WITH OR REMOVED.

TURNING

It is often found that the machine is most easily turned in reverse gear, especially when ground conditions are very wet and sticky, with a considerable amount of earth adhering to the underside of the shield. Provided the rotor is disengaged and the blades are lifted clear of the ground, the machine can be turned quite easily, either in forward or reverse gear. If turning appears to be difficult, check that the differential lock is fully disengaged when the rotor lever is pulled back. Adjustment can be made on the differential lock control rod, should this not be the case.

HANDLEBAR ADJUSTMENT

The height of the handlebars can be adjusted to suit the operator, by means of the alternative holes in the handlebar lugs.

The handlebars can also be offset to one side or the other, by pressing down the handlebar positioning lever to its full extent, and swinging the handlebars to whichever side is required. A hole is provided at each end of the handlebar slide for positive locking in the required position.

HINTS FOR TOP PERFORMANCE

1. The importance of correct and regular lubrication cannot be over-stated. Study the lubrication chart on pages 6 and 7.
2. Do not neglect air cleaner maintenance.
3. Always shut the throttle to the idling position when lifting the clutch lever for engaging or disengaging gears.
4. Do not allow the engine to idle at slow speeds for long periods.
5. Do not press the handles down should the machine jump if hitting a stump or similar obstacle; lightly resist the movement and let the machine right itself. This applies particularly when working on hillsides in badly cleared land.
6. When taking sharp corners, put the rotor out of gear, lifting the handlebars to help in turning.
7. Never run the "Gem" with the engine labouring. Selection of the right gear, and correct depth of work ensures a constant reserve of engine power.
8. Always use the clutch in the same way as in a car, that is, for changing gear only. **DO NOT** "slip the clutch" to obtain extra engine speed.
9. For the first 25 hours, attempt only fairly light work, to allow the working parts to "bed down".

LUBRICATION AND MAINTENANCE

The simple, sturdy construction of the Howard "Gem" enables it to withstand the toughest conditions of work and use. The small amount of maintenance and lubrication detailed below, will, if done regularly, extend its working life and maintain its high efficiency.

BEFORE OILING, ADJUSTING OR SERVICING THE MACHINE SWITCH OFF THE ENGINE

OILS

Use only good quality oils. SAE 90 grade should be used in the gearbox and chaincase; engine oil for all other lubrication points.

AIR CLEANER

The air cleaner is of the oil-bath type, and its maintenance must not be neglected. Never allow sediment to build up in the air cleaner base. In dusty conditions, change the air cleaner oil twice a day; if not changed promptly, the accumulated dust in the oil-bath will raise the level of the oil to a point where dirt-laden oil will be sucked into the engine, to cause immediate and costly damage.

FIRST MAINTENANCE

(If machine not already serviced by dealer):

1. Check engine oil level.
2. Check the air cleaner oil level.
3. Check tightness of all nuts and bolts.
4. Check the gearbox oil level (with the dipstick attached to the square-headed plug screwed into the gearbox top).
5. Check the chaincase oil level; with the blades touching the ground, oil should just seep out of the level hole at the lower rear of the chaincase, with the oil level plug removed.
6. Check the tension of the drive chain; total up and down movement should be no more than $\frac{3}{8}$ in. (9.5 mm.) to $\frac{1}{2}$ in. (12.7 mm.). See Adjustments Section, page 8.
7. Lubricate the rotor stub axle with an oilcan (the oil-way screw is located on the rotor tube just inside the right-hand flange).
8. Oil the rotor dogs; remove the small square-headed plug from the top side of the rotor dog clutch housing and lubricate with several strokes from an oilcan.
9. Lightly oil the throttle cable, the gear, clutch, and rotor control pivots, handlebar swivel and slide, shield hinges and depth control adjustment.
10. Check that the engine clutch is adjusted to give $\frac{1}{4}$ in. (6 mm.) free movement at the handlebar lever. Adjustment should be taken up at the front clutch control arm by means of the wing nut.
11. Check tyre pressures (20 p.s.i. - 1.4 kg./sq.cm.).
12. Check that the weed cutter blades just clear the outside blades of the rotor.

EVERY 10 HOURS OR DAILY

1. Check the engine oil level.
2. Check the level and condition of the air cleaner oil; wash out with petrol and replenish with fresh oil if necessary (twice daily if very dusty conditions).

3. Check tightness of blade bolts, and straighten any bent blades, using the blade setting bar.
4. Watch for signs of excessive rotor clutch slip. Adjust if necessary, on the four spring-loaded clutch nuts on the rotor left-hand end. For normal setting, tighten the nuts to fully compress the springs, then slacken back each nut half a turn.

EVERY 25 HOURS OR WEEKLY

(additional to 10 Hours maintenance)

1. Service the engine (see engine instruction book).
2. Check gearbox oil level.
3. Check chaincase oil level.
4. Check chain tension.
5. Oil rotor dogs.
6. Oil the rotor stub axle bearing.
7. Oil all pivot points, hinges, and other oiling points (see First Maintenance, para. 9 above).
8. Check the engine clutch adjustment and reset if necessary.
9. Remove and clean out the sediment bowl on the fuel tank.
10. Check all nuts and bolts for tightness.
11. Check tyre pressures.
12. Adjust weed cutter blades if necessary.

EVERY 250 HOURS OR 3 MONTHLY

(additional to 10 Hours and 25 Hours maintenance)

1. Drain the gearbox, flush out and refill with 6 pints (3.4 litres) SAE 90 gear oil. (See Adjustments section, page 8).
2. Remove the chaincase, and wash the chain and the case with petrol. Replace and refill with $\frac{3}{8}$ pint (.25 litre) SAE 90 gear oil. (See Adjustments section, page 8).
3. Check the tightness of the hub nuts, i.e. the large nuts which hold the hubs on to the taper splined shafts.
4. Remove air cleaner complete, and flush out with paraffin or kerosene. (See Adjustments section, page 8).

NUTS AND BOLTS

All nuts and bolts must be kept tight, and as a guide, the following chart may help.

Nut Size	Torque	
	lb./ft.	kg./m.
$\frac{1}{4}$ BSW	8.5	1.2
$\frac{5}{16}$ BSW	17.5	2.4
$\frac{3}{8}$ BSW & UNC	31	4.2
$\frac{7}{16}$ BSW & UNC	49.6	6.8
$\frac{1}{2}$ BSW & UNC	73.2	10
$\frac{5}{8}$ BSW	131.9	18.1
$\frac{1}{4}$ BSF	9.5	1.3
$\frac{5}{16}$ BSF	19	2.6
$\frac{7}{16}$ BSF	54.7	7.5
$\frac{1}{2}$ BSF	81.2	11.1
$\frac{5}{8}$ BSF	163	22.3
$\frac{3}{4}$ BSF	283	38.8
Blade Bolt Nut	90.2	12.4

LUBRICATION AND

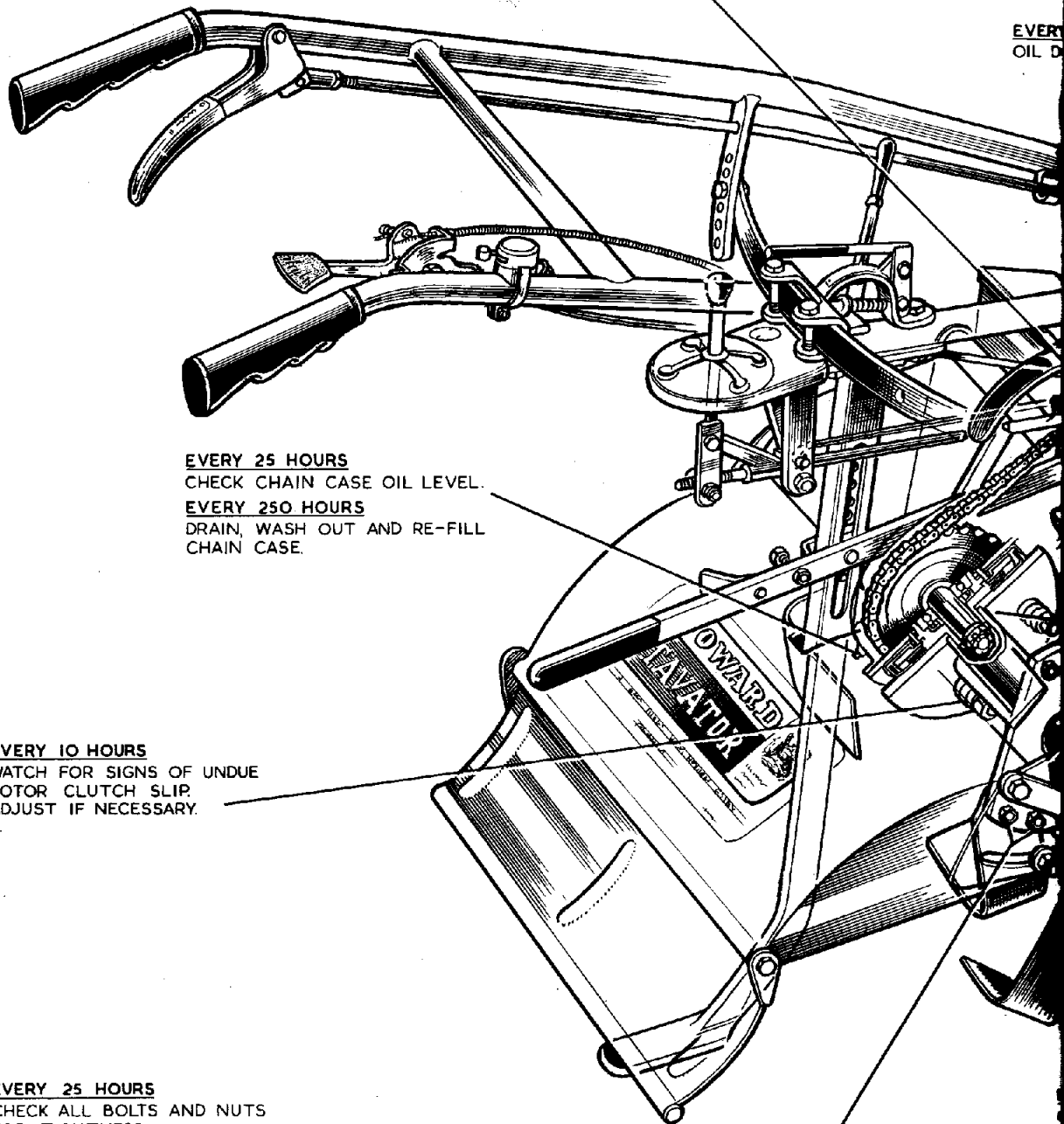
EVERY 25 HOURS

LUBRICATE THROTTLE CABLE, GEAR CLUTCH AND ROTOR CONTROL PIVOTS, HANDLEBAR SWIVEL AND SLIDE SHIELD HINGES, DEPTH CONTROL MECHANISM.

EVERY 25 HOURS
CHECK CHAIN TENSION.

EVERY 25 HOURS
CHECK GEARBOX OIL LEVEL.
EVERY 250 HOURS
DRAIN AND RE-FILL.

EVERY 10 HOURS
OIL DRAIN.



EVERY 25 HOURS
CHECK CHAIN CASE OIL LEVEL.
EVERY 250 HOURS
DRAIN, WASH OUT AND RE-FILL
CHAIN CASE.

EVERY 10 HOURS
WATCH FOR SIGNS OF UNDUE
ROTOR CLUTCH SLIP.
ADJUST IF NECESSARY.

EVERY 25 HOURS
CHECK ALL BOLTS AND NUTS
FOR TIGHTNESS.

EVERY 10 HOURS
CHECK FOR BENT BLADES AND
BLADE BOLT TIGHTNESS.

MAINTENANCE CHART

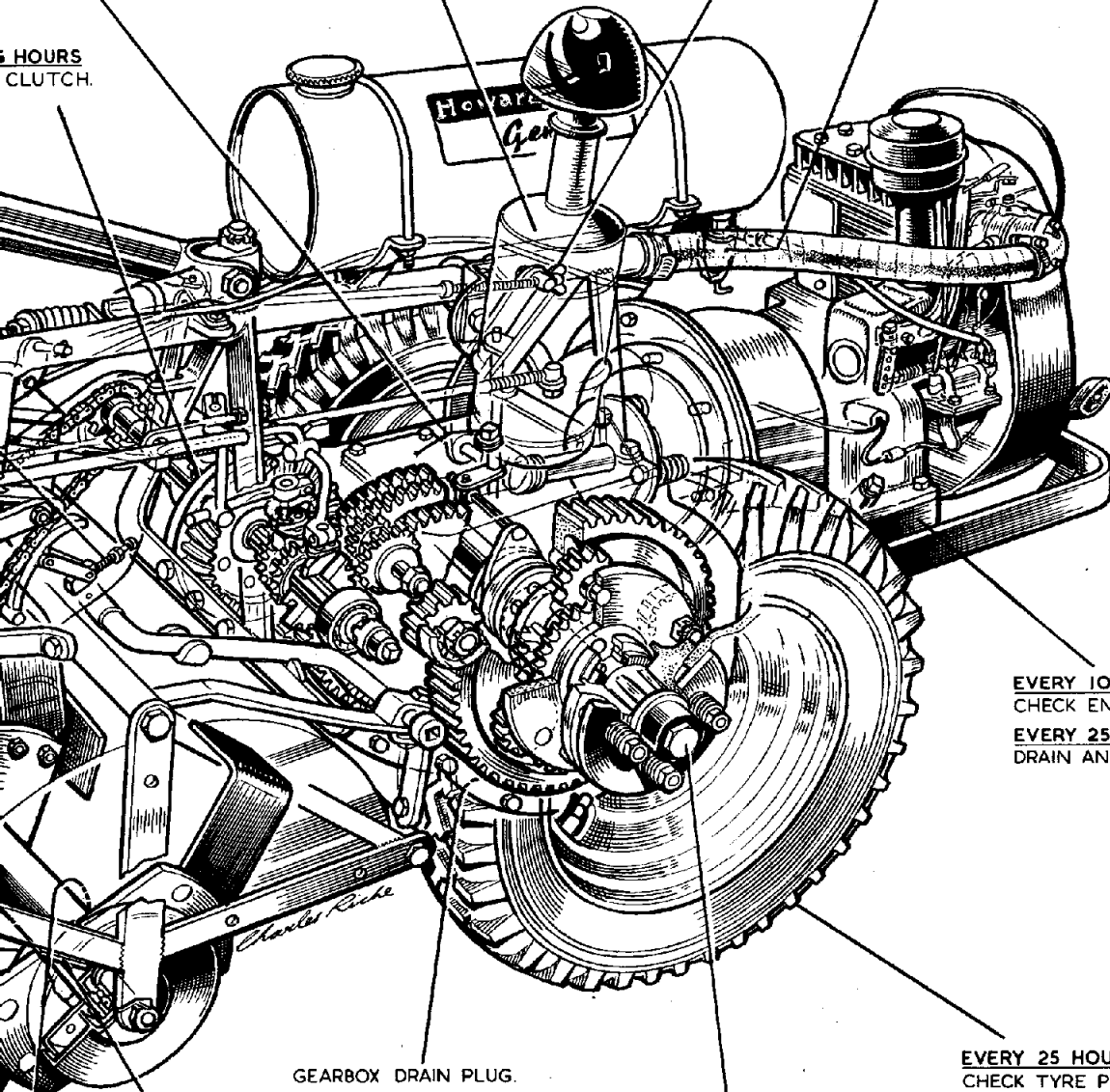
EVERY 25 HOURS
 CHECK CLUTCH ($\frac{1}{4}$ " PLAY AT LEVER)
 ADJUST AT CLUTCH ARM.

**EVERY 10 HOURS (OR TWICE DAILY
 IN VERY DUSTY CONDITIONS.)**
 CHECK AIR CLEANER OIL.

EVERY 25 HOURS
 CLEAN OUT SEDIMENT BOWL.

EVEL.
 ARBOX.

5 HOURS
 CLUTCH.



EVERY 10 HOURS
 CHECK ENGINE OIL LEVEL.
EVERY 25 HOURS
 DRAIN AND RE-FILL ENGINE SUMP.

GEARBOX DRAIN PLUG.

EVERY 25 HOURS
 CHECK TYRE PRESSURE
 (20 LBS. PER SQ. INCH.)

EVERY 250 HOURS
 CHECK HUB NUTS FOR TIGHTNESS.

EVERY 25 HOURS
 ROTOR STUB AXLE.

EVERY 25 HOURS
 CHECK WEED CUTTER BLADES,
 ADJUST IF NECESSARY.

RECOMMENDED LUBRICANTS.

GEARBOX AND CHAIN CASE..... S.A.E. 90.
 ROTOR DOG CLUTCH
 ROTOR STUB AXLE
 DEPTH CONTROL WHEEL (IF FITTED) } USE ENGINE OIL.

ADJUSTMENTS

ROAD WHEELS

Each road wheel is mounted on its hub by a friction clutch device. These are adjusted so that the wheels have sufficient grip to pull the machine, but will slip if they become jammed with an obstruction between the wheels and the frame.

For normal adjustment, tighten each of the four nuts to fully compress the springs, then slacken back each nut half a turn.

Should the wheels appear not be driving, check that the adjustment is correct.

DRIVE CHAIN

Correct drive chain tension is as important as correct lubrication. Total up and down movement should be no more than $\frac{3}{8}$ in. (9.5 mm.) to $\frac{1}{2}$ in. (12.5 mm.). Check with a suitable screwdriver inserted through the oil filler hole on the top side of the chaincase. Turn the screwdriver to grip the chain between the links. Loosen the locknut on the external adjuster on the bottom front of the chaincase, and screw in the adjusting screw to increase chain tension. Re-tighten the locknut.

CLEANING CHAINCASE

After 250 hours of work, the chaincase should be cleaned out. Unscrew all the bolts securing the chaincase to the backplate, allowing the chaincase oil to drain out from the joint; no drain plug is fitted. Remove the cover, ensuring that the gasket is not damaged, and wash out the inside of the case and the chain with petrol or kerosene. Re-assemble, and fill with $\frac{3}{8}$ pint (.25 litre) SAE 90 gear oil.

CLEANING GEARBOX

The gearbox must also be cleaned out after 250 hours work. Unscrew the drain plug on the bottom right-hand inner side of the gearbox and drain the box immediately after a period of running. The oil will be warm and free-running and any sediment will be in suspension in the oil. Replace the drain plug and refill the gearbox with about 6 pints (3.4 litres) of flushing oil. Run the machine for about 3 minutes with the rotor well clear of the ground, then drain the flushing oil. Refill the gearbox with 6 pints (3.4 litres) of good quality SAE 90 gear oil.

ROTOR FRICTION DRIVE

The rotor to which the blades are bolted is driven direct from the main gearbox through a friction clutch. This clutch should only operate when the rotor blades strike an obstacle; when despatched from the factory the

clutch is adjusted so that no slip occurs under normal working conditions. If the clutch appears to slip too easily, it can be adjusted by tightening the four clutch nuts to fully compress the springs, then slackening back each nut half a turn.

AIR CLEANER

The air cleaner oilbath oil level must be checked every 10 hours, or every 5 hours in very dusty conditions. Every 250 hours, the air cleaner interior must be cleaned out. Undo the two nuts *behind* the air cleaner, to separate the air cleaner from the support bracket on the main frame, and undo the jubilee clip on the end of the air cleaner hose to disconnect the cleaner completely. Remove the black, domed pre-cleaner from the top of the air cleaner, and flush out the interior of the air cleaner with paraffin or kerosene, to remove all dirt and dust from the wire gauze elements inside.

When clean, refit the pre-cleaner and secure the air cleaner on the support bracket. Re-connect the hose.

MAINTENANCE OF BLADES

Only the cutting edges of the blades should rub in the soil; the backs of the blades should be clear.

The blades are so designed that use in average soils should keep them sharp. If the ground is very stony however, it is recommended that two sets of hoe blades be used alternately, so that one set may be kept sharpened.

The efficiency of the machine is determined largely by the condition of the blades. If they are left bent or distorted through striking solid obstacles in the ground, they will require double the power to drive, the quality of the work will be poor and the blades will wear much more quickly. Trouble will also arise with clogging under the shield. Blades must therefore be examined daily and any bent ones replaced immediately.

ROTOR FLANGE WEEDCUTTERS

Two weedcutter blades are provided, one at each side of the machine, to prevent long grass or weeds binding around the end rotor flanges. The blades are slotted and secured by two setscrews each, and should be adjusted so that they just clear the rotor flanges when the rotor is turned BY HAND. Severe power losses will occur in weedy conditions unless these blades are correctly adjusted.

ROTORS AND BLADES

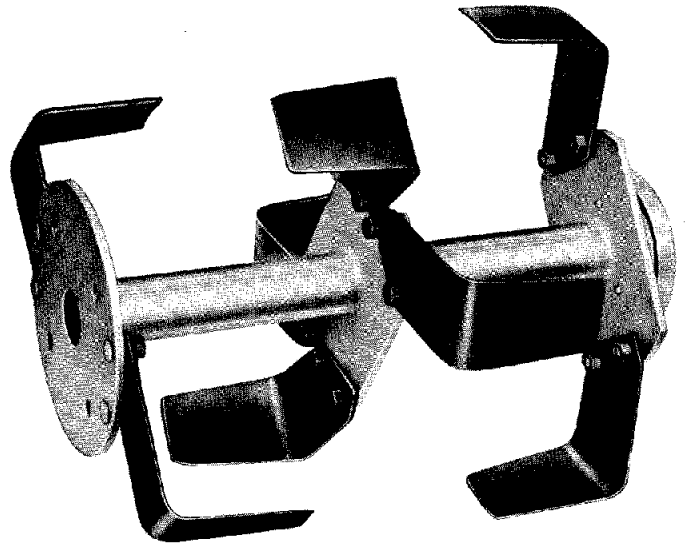
BLADES

The Howard "Gem" is normally delivered with the blades already fitted. If it is necessary to fit your own blades, this is done as follows:

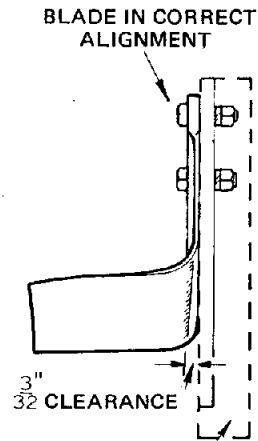
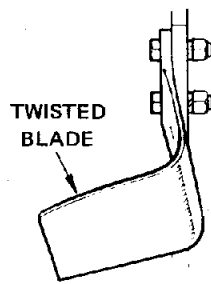
1. Identify left-hand and right-hand blades.
2. The left-hand end flange carries two right-hand blades; the right-hand end carries two left-hand blades.
3. The centre flange (or flanges, depending on the machine width), carries two left-hand and two right-hand blades leading. The blades should be fitted to the left-hand side of the centre flange(s), with the heads of the bolts against the blades and spring washers and nuts against the flange.

PICTINE ROTOR

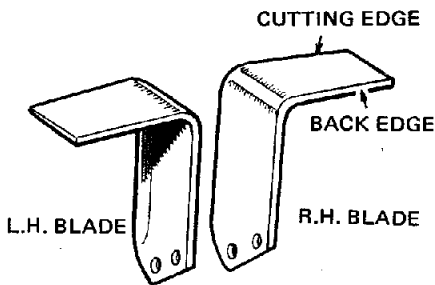
In addition, a Pictine rotor, with flanges closer-spaced than the standard rotor, is available for use with pic-tines or pasture renovating (lucerne) tines, for very hard soil conditions, or for pasture renovation. (See Attach-ments section, page 10).



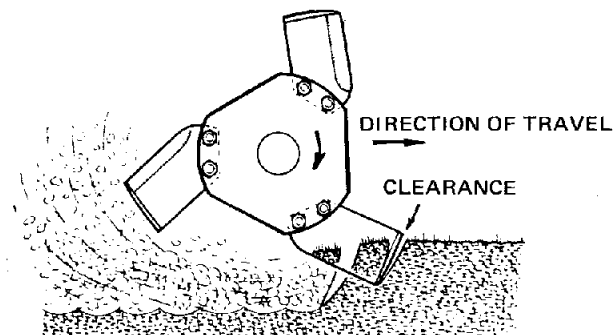
Gem Rotor (20 in. model), 24 in. and 30 in. rotors have two centre flanges



STRAIGHT EDGE

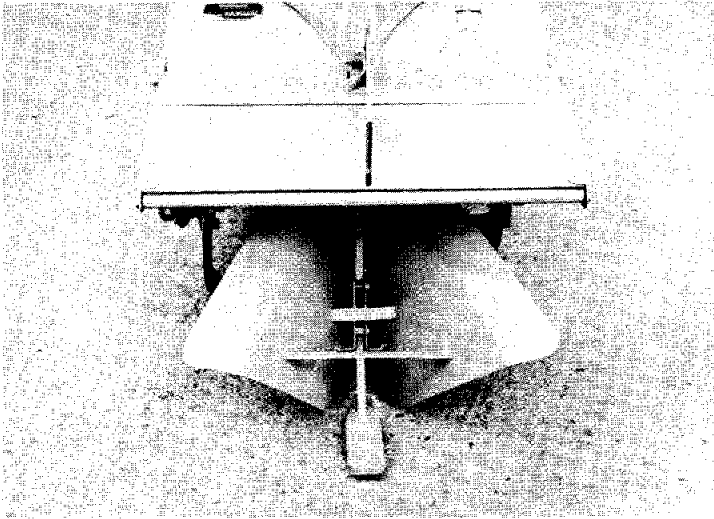


How to identify right and left-hand blades.



Correct blade setting showing clearance at back of blade.

ATTACHMENTS



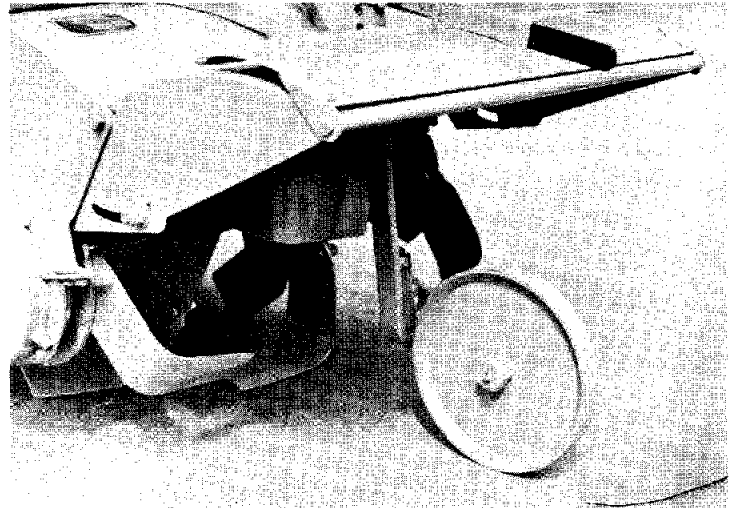
FURROWER

The Furrower is fitted on the depth control skid. Pivot the depth control lever clip and move the lever sideways to withdraw the skid engagement pin. Pull out the skid from the socket under the rotor shield.

Assemble the furrower on the skid leaving the furrower bottom $\frac{1}{2}$ in. (1.25 cm.) above the foot of the skid, or as required for the crop to be planted, then tighten the locking nut. Fit the assembly into the socket and connect to the depth control lever.

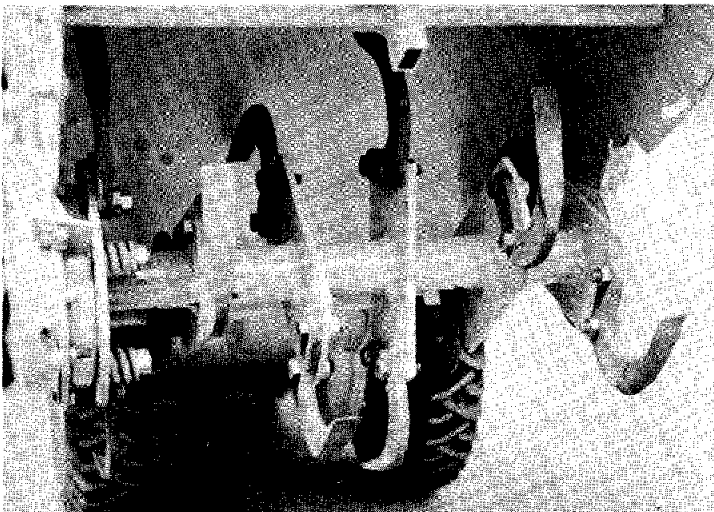
For machines fitted with a depth control wheel instead of a skid, order a skid in addition to the furrower.

When using the furrower, the rotor is put into gear so that cultivating and furrowing are done simultaneously.



DEPTH CONTROL WHEEL

A Depth Control Wheel is standard with 24 in. and 30 in. models, but optional, in place of the skid, on the 20 in. "Gem".



PICTINE ROTOR

The Pictine Rotor with flanges spaced closer than on the standard rotor can be fitted with pic tines or pasture renovating (lucerne) tines.

The pictines have a horizontal chisel point, and are used for breaking up very hard ground, old tracks, etc. The pasture renovating tines have a vertical knife edge, and are used to tear up and aerate old matted turf, to encourage fresh growth of young grasses.

To fit the pictine rotor, slacken off all the nuts and bolts holding the support bracket which carries the stub axle, staytube and rotor shield. Remove the four rotor clutch nuts and springs. Spring the bracket off the stub axle, using a suitable bar, and slide the rotor sideways to remove. Then reverse the sequence to fit the pictine rotor, ensuring that all nuts are correctly tightened and rotor clutch adjusted.

NOT ILLUSTRATED:—FRONT-END WEIGHTS

MAKING THE MOST OF YOUR "GEM"

GENERAL

As the scope of operation is so wide, and, as soil tillage methods differ so greatly according to crop, climate and soil condition, it is not possible to deal more than superficially with this aspect. However, it is hoped that the following hints will help the user to obtain the best results from the machine.

The Howard "Gem" will cultivate to a maximum depth of 9 in. (23 cm.). On certain, especially the heavier, types of soil, this depth will not be obtained in a single pass. Where cultivation in depth is needed, a first pass should be made at 3-4 in. (7-10 cm.), followed by a further pass at full depth.

The low gear must be used when cultivating ground which is very hard or covered with heavy growths. Second gear is used for all ordinary cultivation, and top gear for light cultivation. Always work in the highest gear that will produce the quality of tilth necessary. Always use top gear for running the machine between jobs. A depth control skid or a wheel, is fitted, and by moving this up and down the depth of work can be controlled in $\frac{3}{4}$ in. (19 mm.) stages down to 9 in. (23 cm.) deep.

If the surface of the ground is very hard or baked, the depth control should be adjusted so that the machine just bites the surface. Further passes should then be made until the required depth is reached.

On heavy land which is to be laid up for the winter, the surface should be left rough. By using the ridging or furrowing attachment during this final or late autumn cultivation, the land can be left in ridges to promote better drainage and to expose a greater surface area to the weather.

If heavy land is Rotavated too finely and left bare to the winter rains, the soil may pack together, making spring cultivations difficult.

When cultivating a ploughed field, the "Gem" should be run across the furrows, not along them. This will ensure complete cultivation.

On hilly ground always run the machine around the contour, working from the top to the bottom of the hill. After the first cut, one road wheel can be run in the soil just worked, so that any tendency to slip will be countered by the wheel coming against a wall of uncut soil.

On light soils, two courses are open. The ground may either be left rough, or it may be Rotavated to medium depth and sown to a green crop, e.g. rye. The green crop will prevent the leaching out of the nitrogen in the

soil. In the early part of the year the crop is then Rotavated. After a week or ten days, the spring seed bed may be prepared. This Rotavation should be shallower than that used to work-in the green crop.

SEED BEDS

In ground which has been cultivated properly, seed beds should seldom exceed 2 in. (5 cm.) in depth, except for certain crops. Seeds require a well-aerated soil with a firm bottom. Some small seeds require a seed bed to be lightly consolidated. This is particularly important on light soil, where consolidation will bring moisture nearer to the seedling plant.

Competition from weeds is most critical when the crop is at the seedling stage. To obtain weed-free seed beds, the ground should be prepared a few weeks ahead of the sowing dates. Rotavation should be carried out at a depth of 4 in. (10 cm.); this causes any weed seeds to germinate. These weeds may be turned in by a second Rotavation, which will prepare the seed bed at the same time. It is most important that this second Rotavation is shallower than the first. Remember that the ground is now more open, so that the machine will tend to dig more deeply. When the seed bed has been prepared, it should ideally be allowed to settle for 24 hours before sowing.

WEED CONTROL

Rotavation produces a well-aerated warm seed bed in which germination takes place readily. Inevitably, such conditions also favour weed seeds.

Weeds are eliminated by preventing them seeding or by progressive weakening of the deep tap roots or rhizomes. Weeds are killed most easily and inexpensively by Rotavating them directly they show green. Annuals will be killed outright and perennials will be reduced until they too, die out. This is true even of such persistent weeds as couch or twitch.

ROW-CROP WORK

Work will be easier if rows are made as long as possible. At least 3 ft. (1 m.) should be allowed at each end for turning.

Weeds between rows may be controlled by Rotavation. Ideally, this should be done when the weeds are small, but even a heavy growth can be turned in.

This will not prevent weeds growing in the rows themselves; such weeds must be controlled by hand-hoeing when small. Should land become weed-infested because these weeds have been allowed to seed, the

following crop should be a cleaning crop, e.g. roots or potatoes, which will give a period of several weeks in the early part of the year when the weed seeds will shoot and can be killed by Rotavation.

In planning your crops to make the best use of the "Gem", allow 2 or 3 in. (5 or 7 cm.) over the effective width on each side of the machine.

GREEN MANURING

Land not immediately required may be sown down to such crops as mustard or rye grass during spring and summer, or rye during the winter. These crops should be allowed to mature if they are to be used as green manures – they will then have the best effect on the soil. A winter cover crop will preserve plant foods which

would otherwise be leached away, so it need not be allowed to mature.

LAND RECLAMATION

The "Gem" may also be used to bring derelict land back into cultivation. Virgin ground or soil tightly bound with roots or grass is best cultivated by first working at only a shallow depth, to break up the surface. Depth can then be gradually increased by subsequent passes made at intervals of about a week or ten days.

CONCLUSION

Never overtax the power of the machine. Far better results will be obtained from working in easy stages, rather than by forcing the machine to do work in excess of its horsepower.

The right to alter and/or amend all designs, specifications and/or prices without prior notice is strictly reserved.