OPERATORS HANDBOOK

No. 39 & 46

Universal Thread Grinding Machines

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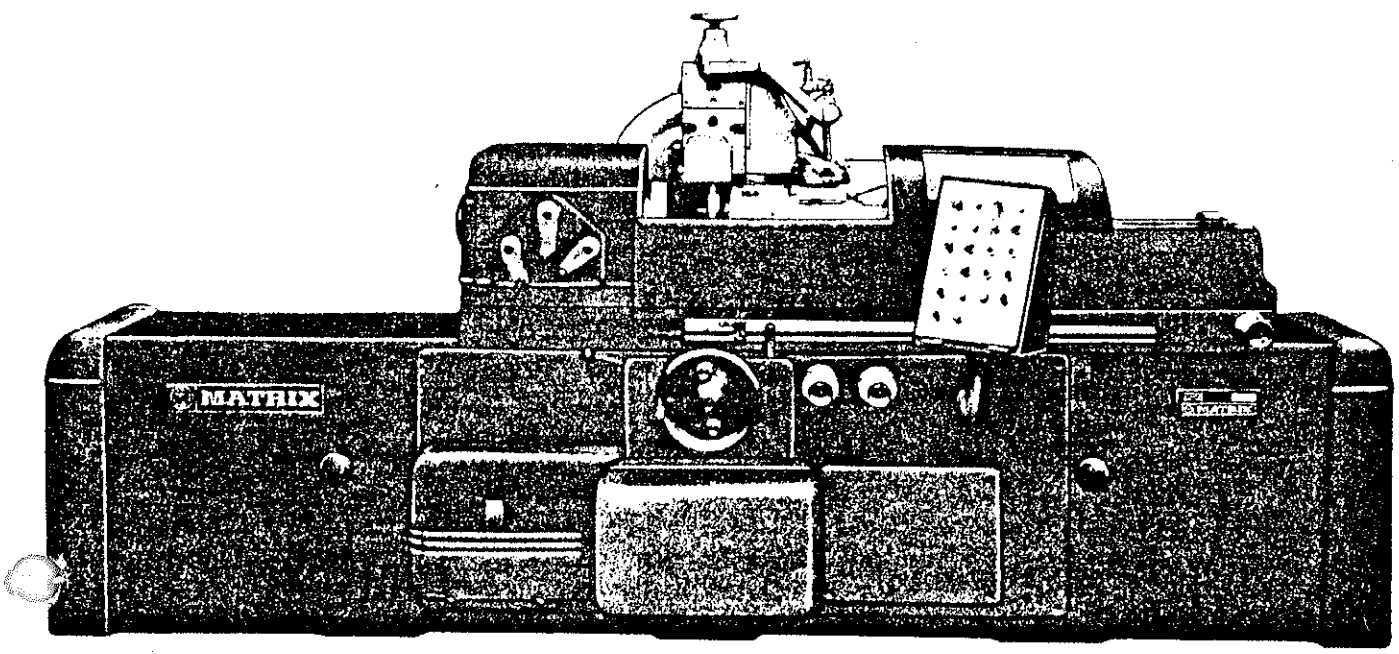


TECHNICAL PUBLICATIONS DEPARTMENT
TI MATRIX LIMITED
P O BOX 39
COVENTRY CV4 9DA
TELE: (0203) 75521 TELEX: 311061

MATRIX MATRIX—39 & MATRIX 46

Health and Safety

Matrix Machine Tools have a Safety Record of which they are justly proud and in issuing this Handbook they would like to bring to your attention Section 6 of the Health and Safety at Work Act 1974 which requires that we supply a machine that is designed and constructed as far as is reasonably practicable to be safe and without risk to health.

Attention is drawn to Section 7 - Duties Placed On Employed Persons.

GUARDS

Factory employers are required, by Law, to guard and/or fence all dangerous parts of machinery.

Employees are also required, by Law, to use all the guards supplied as above.

1. FIXED GUARDS MUST NEVER BE REMOVED WITHOUT PERMISSION
2. ADJUSTABLE GUARDS MUST NOT BE REMOVED EXCEPT WHEN NECESSARY DURING SETTING UP OPERATIONS
3. ALL GUARDS MUST BE IN THEIR PROPER POSITIONS BEFORE MACHINERY IS SET IN MOTION
4. DO NOT CLEAN ANY PARTS OF THE MACHINE WHILST MACHINE IS IN MOTION
5. WEAR THE CORRECT PROTECTIVE EQUIPMENT AT ALL TIMES IN THE WORKSHOP
6. YOU MUST NOT USE ANY MACHINE UNLESS YOU HAVE BEEN AUTHORISED TO DO SO
7. DO NOT LEAVE TOOLS OR LOOSE ARTICLES ON MACHINE TABLES AND SLIDES
8. IF YOU SUSPECT YOUR MACHINE IS DEFECTIVE STOP IT. NEVER ATTEMPT TO REPAIR IT YOURSELF, ESPECIALLY IF IT IS A SUSPECTED ELECTRICAL FAULT. SWITCH OFF THE MAIN ISOLATOR SWITCH AND REPORT THE MATTER TO YOUR SUPERVISOR

Make yourself familiar with the Protection of Eyes Regulation, the Abrasive Wheels Regulation and the duty of all employees under the Health and Safety at Work Act.

Section 7 - States it shall be the duty of every employee while at work:-

(a) To take reasonable care of the Health and Safety of himself and other persons who may be effected by his acts or omissions at work, and

(b) As regards any duty or requirement imposed on his employer or any other person by or under any of the relevant statutory provisions, to co-operate with him so far as is necessary to enable that duty or requirement to be performed or complied with.

GRINDING WHEELS

Throughout the full range of Thread Grinding Machines produced by this Company for more than forty years, it has been Matrix policy to mount grinding wheels to adaptors WITHOUT the use of washers (blotters) of compressible material in order to obtain the most accurate location of the grinding wheel.

Two principle factors make this policy acceptable to the Health and Safety Executive.

1. The use of specially designed wheel adaptors made to close tolerances and incorporating 'Heel and Toe' clamping.

   This prevents excessive force being applied to the wheel.

2) The use of abrasive wheels manufactured to special close tolerances for thickness and parallelism as specified by TI Matrix Limited.

   It is essential that correct tolerance wheels are used and that they are mounted on correct adaptors.

   See Section, for Grinding Wheel Tolerances and Adaptor reference numbers.

MATRIX

INDEX

INSTALLATION

UNPACKING

1. Machines are despatched fully assembled with the exception of ancillary equipment, the feedscrew bridge and wheelhead weights all of which are packed separately. All wrappings should be examined carefully to ensure that no item of equipment is overlooked. Check each item against the despatch notes and examine for damage in transit.

MACHINE SITE

2. It is important that the proposed site is chosen carefully. A ground floor site is essential and should be remote from machinery liable to cause vibration. The site should not be subject to large ambient temperature variations.

3. In accordance with the total floor area required for the installation prepare a solid, level concrete foundation to a depth of approximately 20 in. (500 mm); this depth may require to be increased depending on prevailing soil conditions. Allow sufficient surrounding space for machine operation and maintenance.

LIFTING

4. Insert suitable lifting bars through the apertures in the machine base casting and arrange the lifting tackle as illustrated in Fig.5. Ensure that the slings are clear of the machine table and slideways. Check that the balance is correct and carefully hoist the machine on to the prepared site. Machine nett weights are as follows.
No. 39 Machine - 5 tons 0 cwt. (5090 kg.)
No. 46 Machine - 5 tons 17 cwt. (5590 kg.)

WARNING Do not transport the machine to the site on rollers; Vibration incurred will be detrimental to the accuracy of the machine.

REMOVING THE TRANSPORTATION ITEMS

5. For transit purposes the wheelhead slide will be held clear of the mounting rollers by six brass packing pieces; three of these being inserted at each end of the wheelhead slide; the wheelhead will also have been secured by white painted transit clamps.

WARNING Do not attempt to traverse the wheelhead while the clamps are fitted.

6. Remove the two clamps (Fig. 6) from the wheelhead together with the clamp anchor pieces; insert the grubscrews supplied in the anchor piece bolt holes.

7. Insert a 2 BA. screw in each of the slide packing pieces and utilising the special lever supplied, carefully raise the wheelhead the minimum amount necessary to permit the packing pieces to be withdrawn.

WARNING Excessive lift will damage the wheelhead feedscrew.

8. Operate the feed handwheel to retract the wheelhead and apply a thin film of jointing compound to the wheelhead side end plate abutment faces. Refit the four end plates and the feedscrew bridge.

9. Label and store the transit items for future use should the machine be re-sited.

CLEANING

10. Remove all adherant grease and rust inhibitor from the machine with a suitable solvent and apply a film of light machine oil to all machined and bright surfaces.

LEVELLING

11. The machine base incorporates three integral machined feet for levelling. Allow the machine to settle on the site and pass a precision level over the horizontal and transverse surfaces, it is essential that the machine is sited perfectly level and in a free-standing condition. Should adjustment be necessary to achieve a true level the machine should be raised by the insertion of crow-bars under the base casting and shims of the required thickness positioned under the appropriate levelling foot. Do Not hammer steel wedges under the machine or employ any method which may result in permanent distortion of the base casting.

WARNING: Do not bolt the machine to the foundation.

WHEELHEAD WEIGHTS

12. For transit purposes the wheelhead weights will have been removed, these are re-fitted as follows:

Remove the aperture cover plate from the rear of the base casting. Release the balance weight chain mounted platform (located through the aperture) and mount the two weights in such an attitude that they will interlock. Refit the cover plate.

SLIDE BLIND WEIGHTS

13. 39 Machine: Remove the louvered covers from the ends of the base casting, and assemble the hooked weights to the slide blind covers. Replace the end cover plates.

46 Machine: The end weights are rigidly held by bolts which pass through the weights and machine base. Remove the bolts and store with the transit items.

LUBRICATION

14. Check the machine oil levels and charge all lubrication nipples. Lubrication charts and recommended lubricants will be found in Section 'R'.

COOLANT CONNECTION

15. Coolant hose connections are push-fit, secured by hose clips. If the standard coolant unit is installed, return hoses will not be necessary; the coolant 'free falls' into the tank from a rigid duct. For alternative coolant equipment see Figs. 3 and 4.

ELECTRICS

16. Ensure that the supply envisaged is compatible with the machine wiring. Unlock the cubicle access door and place the isolator switch in the 'OFF' position, access can now be gained to the cubicle. Wiring diagrams and electrical data sheets are contained in a special pocket in the cubicle, it is recommended that they are retained in this stowage in order that they will be readily available to maintenance staff. Wiring diagrams are not re-produced in this handbook but additional copies can be made available on request. Quote the machine serial number on all correspondence.

17. Pass the incoming supply cable through the aperture in the cubicle and connect the earth wire to the connection on the side of the cubicle, connect the three phase wires to the terminals L1, L2 and L3. External sockets on the cabinet provide for coolant, clarifier, machine lighting, etc.

PHASING CHECK

18. (1) Select 'CONTINUOUS' on the control station coolant switch and close the supply cocks. Place all other controls in the 'OFF' position.

(2) Press the control station 'MASTER START' and note the rotational direction of the coolant pump motor. Rotation should be in accordance with the arrow on the motor cover. Should the rotational direction be incorrect isolate the machine and interchange any two of the incoming phase wires.

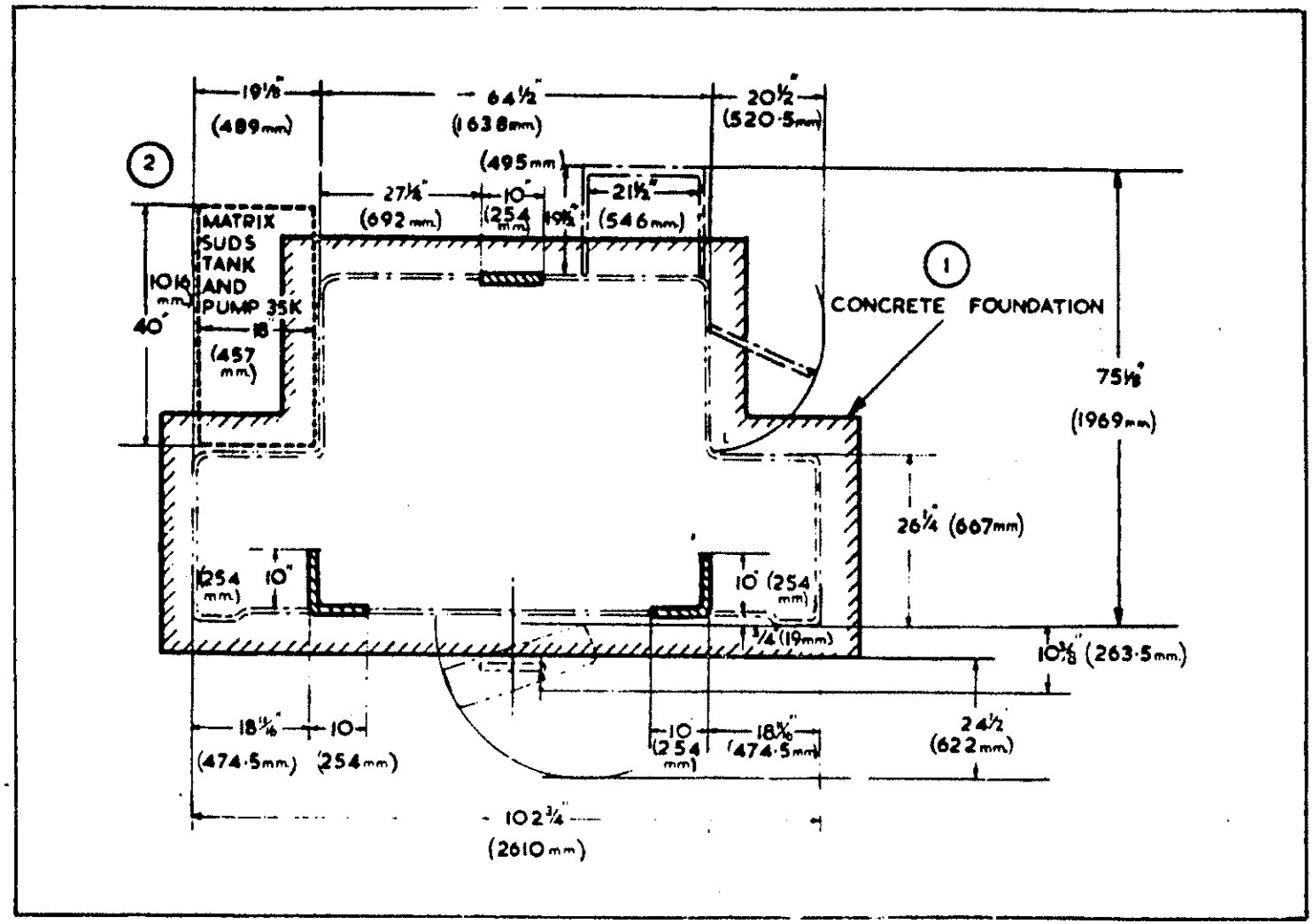


Fig. 1 Foundation plan No. 39 Machine

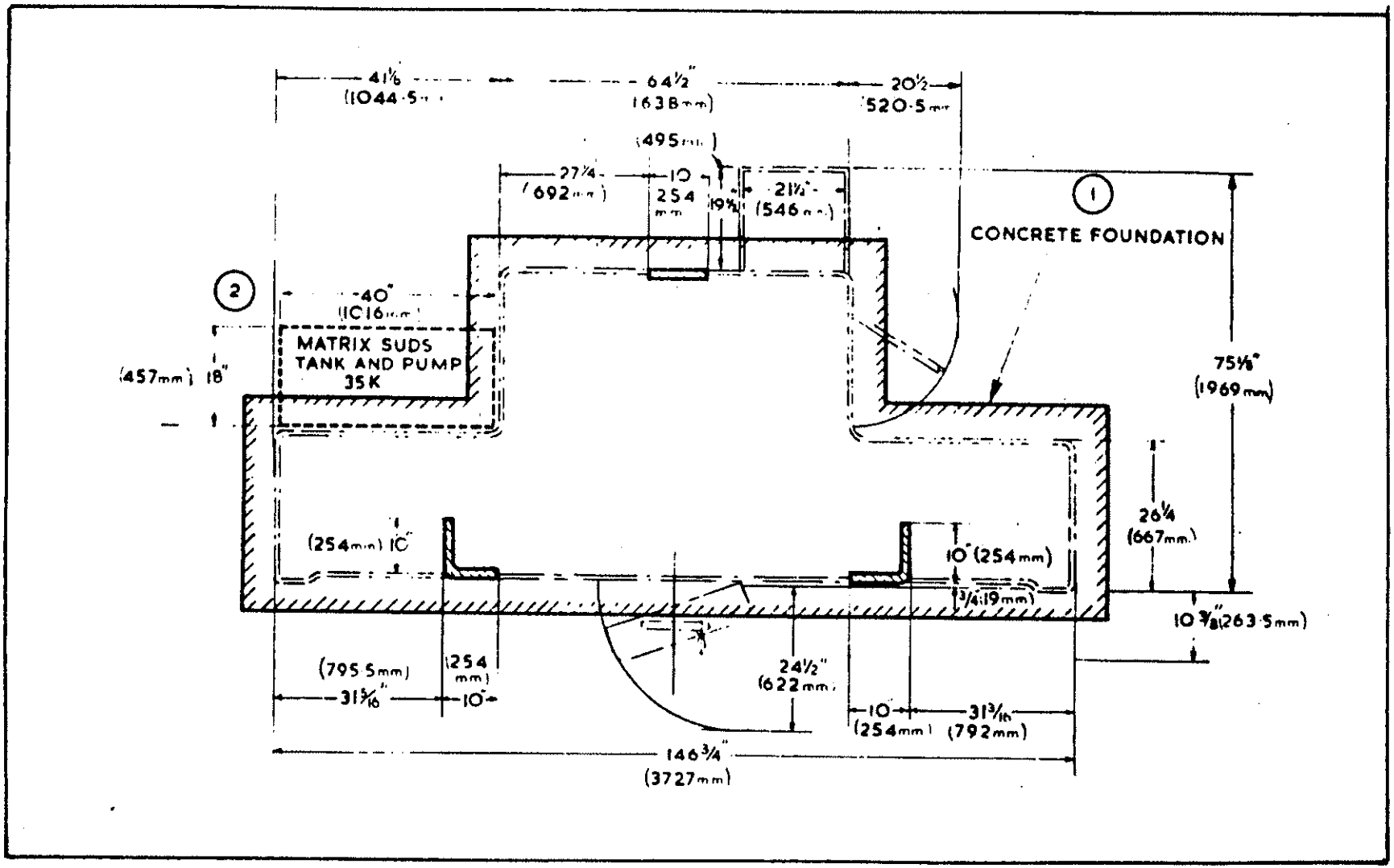


Fig. 2 Foundation plan No. 46 Machine

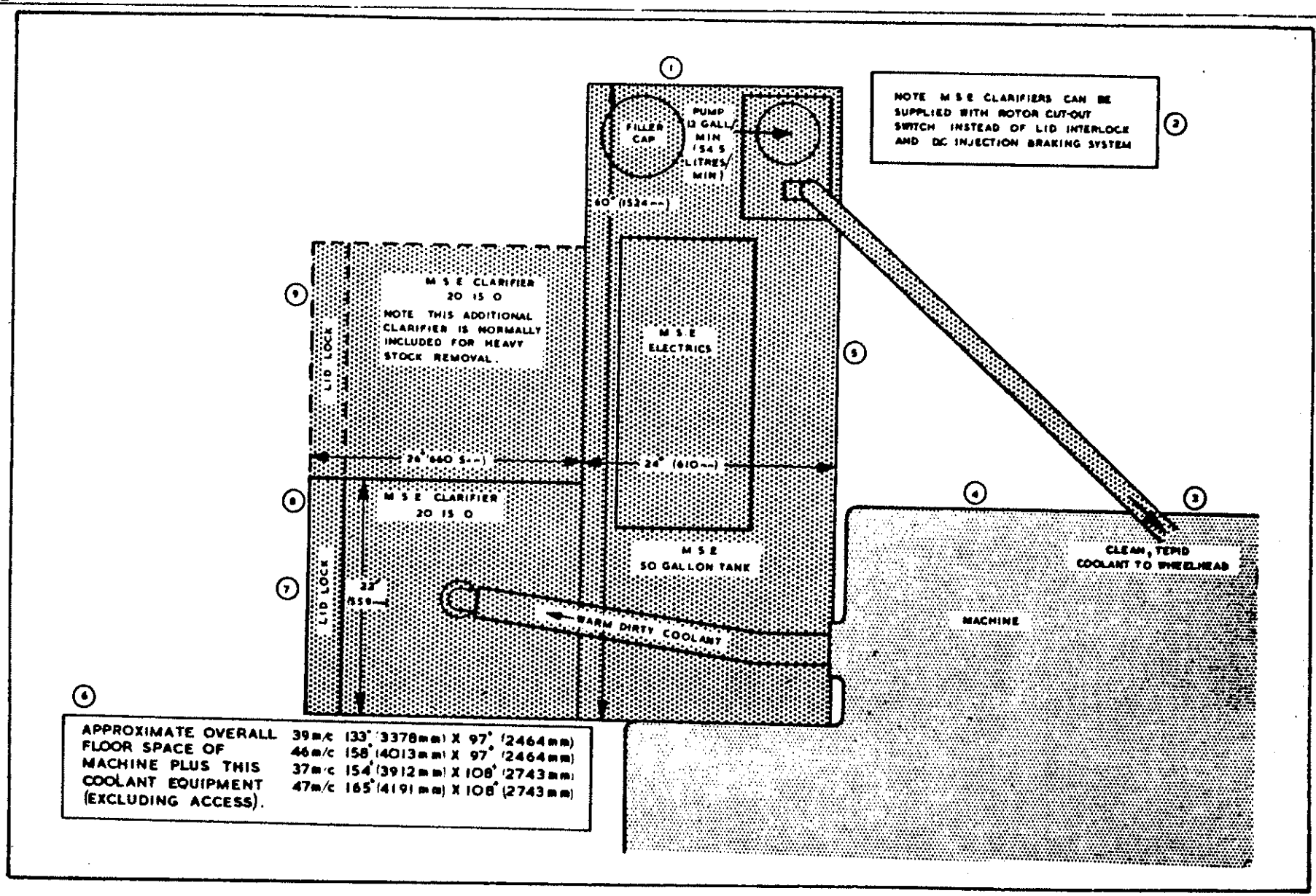


Fig. 3 Floor plan optional coolant equipment

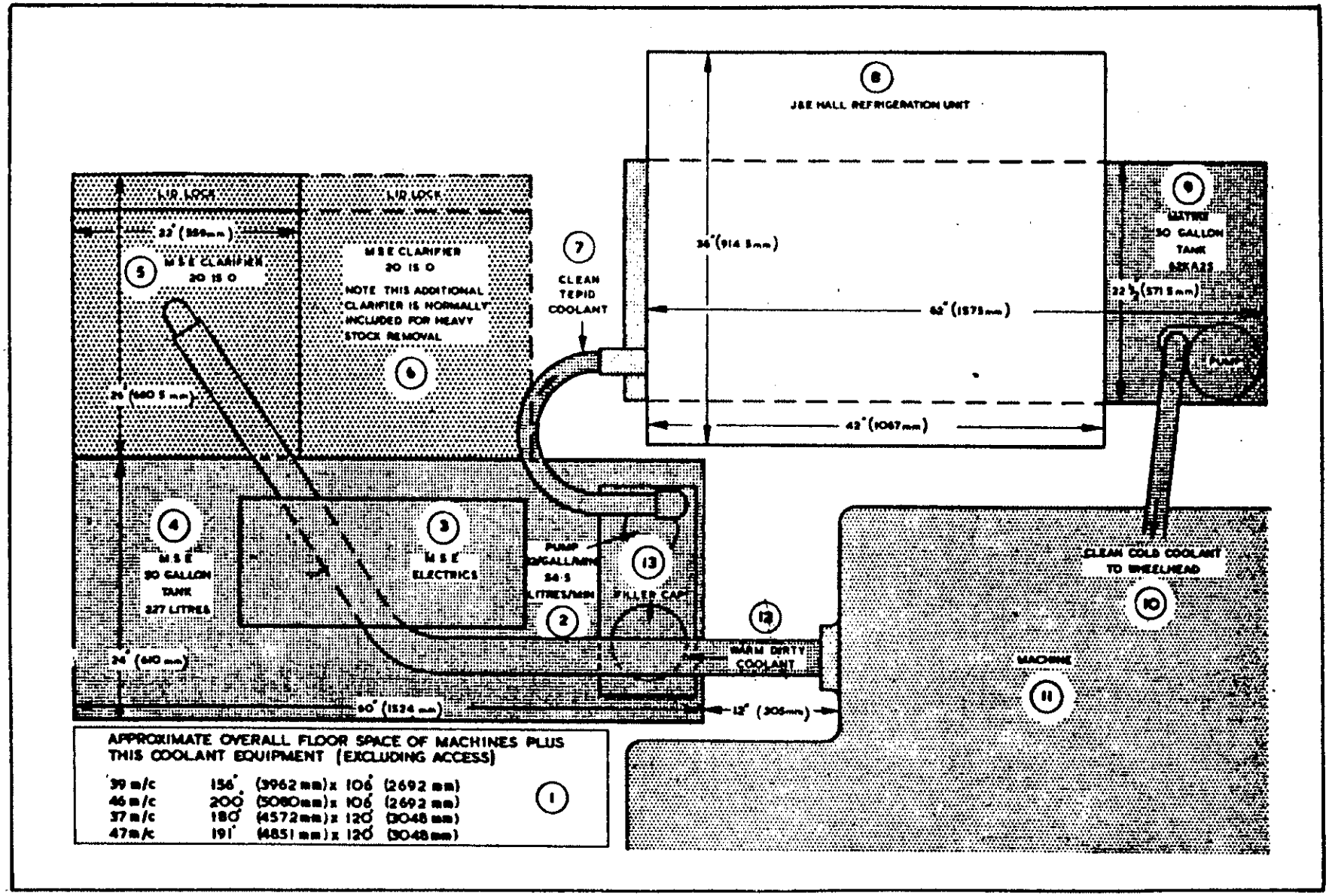


Fig. 4 Floor Plan optional coolant equipment

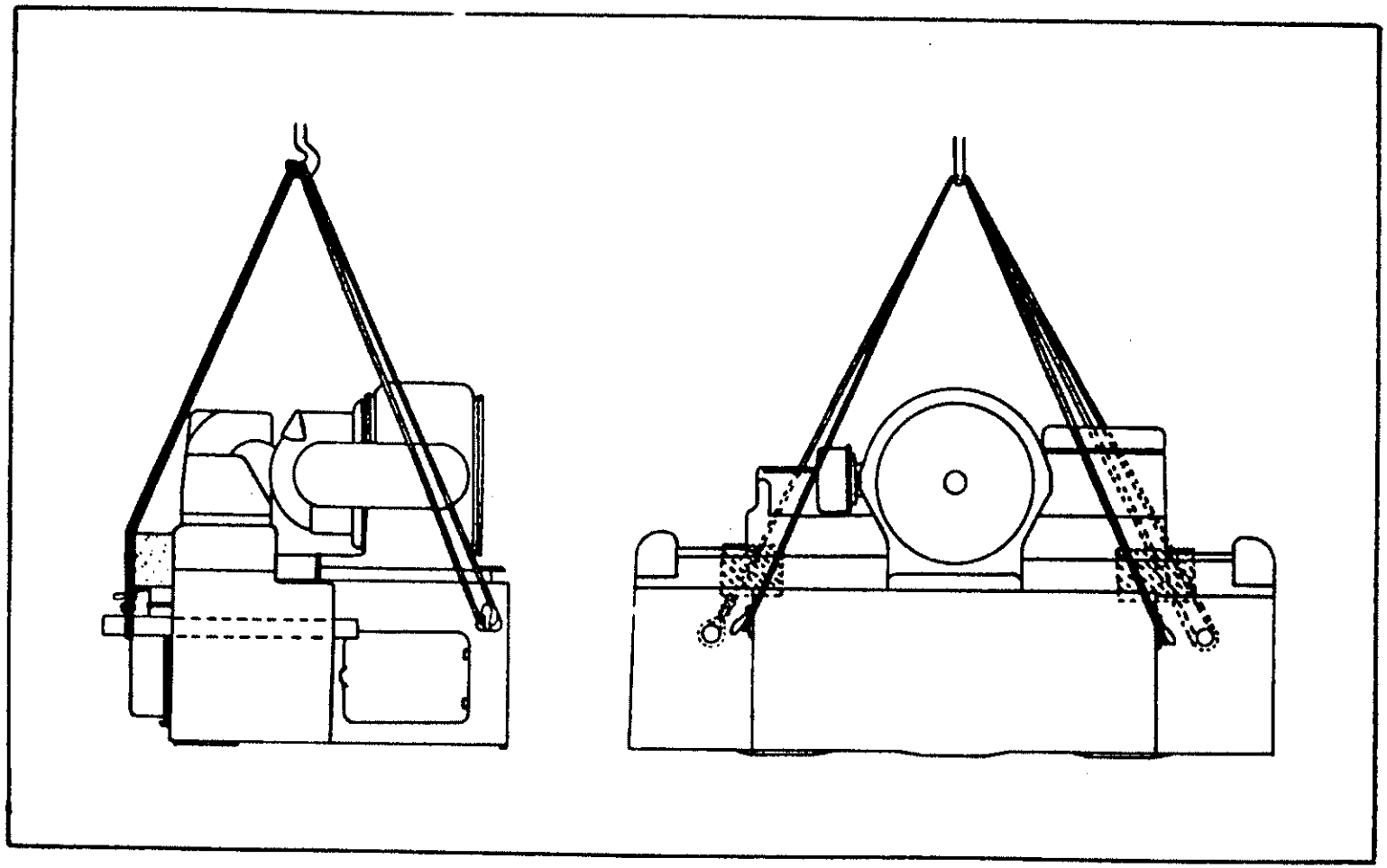


Fig. 5 Arrangement of lifting tackle

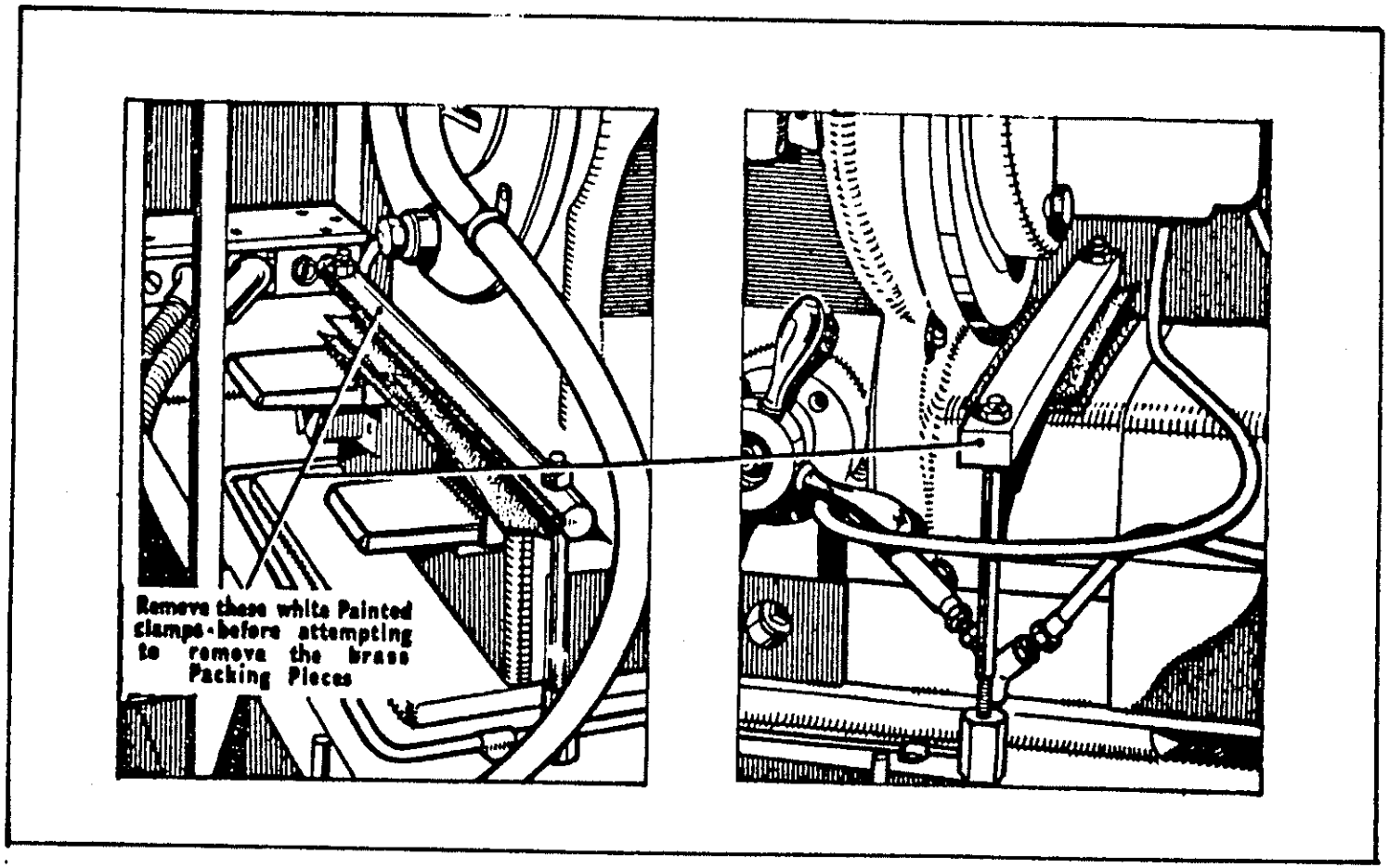


Fig. 6 Transportation clamps

INTRODUCTION

1. A prior study of Fig. 1. will acquaint the operator with the basic units and machine controls each of which is fully described in the following paragraphs.

WORKHEAD AND WORKSLIDE

2. The workslide comprises upper and lower sections and is mounted on the machine base in vee and flat rollerways. Workslide traverse is effected by a precision leadscrew driven through pitch change gears from the gearbox at the front of the machine base.

SLIDE TRAVERSE

3. Right and left hand workslide traverse is effected by the traverse control lever. Lever positions for left or right hand traverse are illustrated in Figs. 2 and 3. Reverse selection of the control lever returns the workslide at the pre-selected return speed.

4. As the slide approaches the end of its traverse the traverse control stops move the control lever to the 'mid' position, discontinuing the traverse.

NOTE: Workslide traverse cannot be reversed under normal conditions if the workpiece is in contact with the grinding wheel. Refer to the paragraph 'Rapid throwout'.

PITCH CHANGE GEARS

5. Pitch change gears are selected and mounted for the required pitch in accordance with the information plate affixed to the workhead hinged coverplate. Change gear arrangements for both right and left hand component threads are illustrated in Figs. 4 and 5.

NOTE: An intermediate idler gear requires to be introduced into the gear train for L.H. thread production.

6. The workslide may be traversed manually if required, this is effected by removing the pick-off gears from the gearbox (Fig. 8) and mounting the cranked pitching handle to the pitch change gear driving shaft. Manual workslide traverse without workpiece rotation can be obtained by disengaging the spindle drive pitch change gear to mount the pitching handle to the final drive gear shaft.

WORKHEAD SELECTOR LEVERS

7. Mounted on the front of the workhead the right hand lever selects the workspindle engage/disengage drive.

8. The centre handle makes provision for annular dividing i.e. manual workslide traverse. Ten revolutions of the annular dividing handle will cause the workslide to be traversed a distance equal to one pitch; the pitch ratio-selector being positioned at 'high ratio'.

9. The pitch ratio lever has three selective positions 'High Ratio', 'Low Ratio' and 'Annular'. High or Low ratio are selected as required by the type of work in process, high ratio being selected when grinding components with leads of up to 1 in. (25 mm). Low ratio provides a 4 to 1 reduction and is suitable for worm or coarse pitch work. Pitch change gears being mounted in accordance

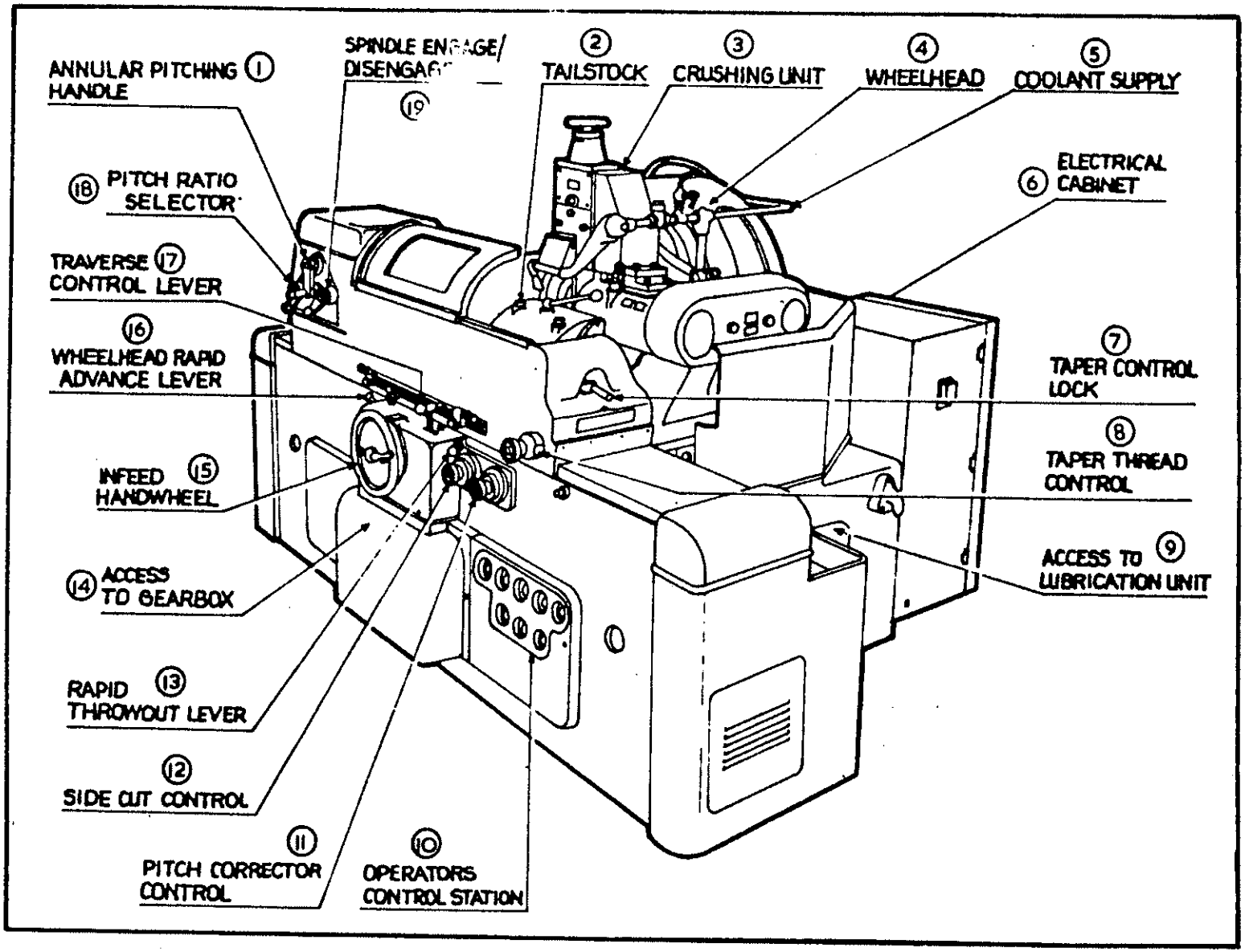


Fig. 1 Machine controls

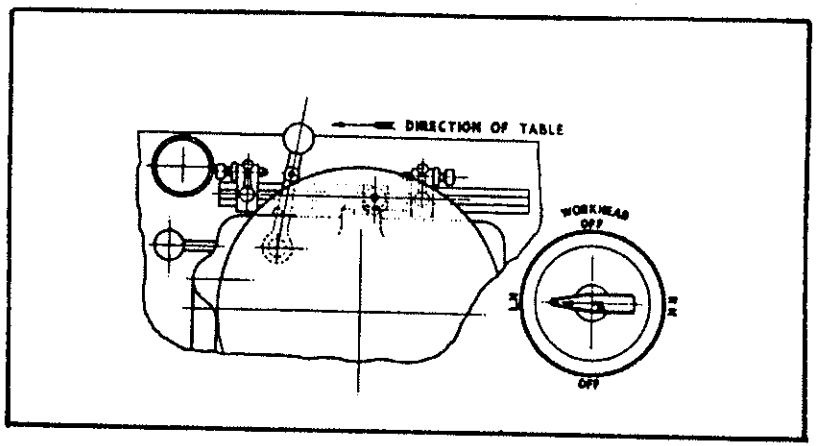


Fig. 2 Traverse control lever position L.H. work

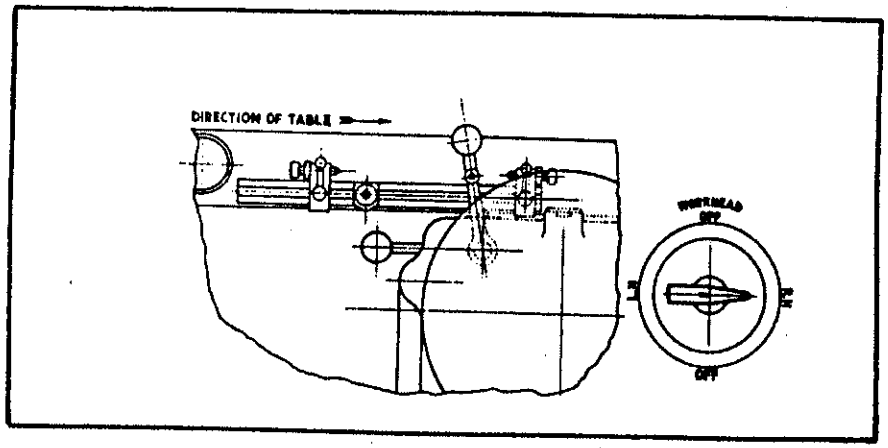


Fig. 3 Traverse control lever position R.H. work

with the selected ratio.

10. The third lever position is 'Annular', this disengages the work-slide traverse allowing the faceplate to revolve independently.

OVERLOAD CLUTCH

11. Motor drive to the workhead is transmitted via. an overload clutch. The clutch is designed to slip when subjected to excessive overloading, usually caused when too fast a slide return speed is used with a heavy component mounted.

WORKSPINDLE AND MULTI-START WORK

12. The workhead spindle incorporates a 'live' centre and the periphery of the faceplate is graduated for indexing either 2, 3, 4, 5, 6, 8, 10 or 12 starts (see Fig. 6.) At the commencement of a multi-start operation the faceplate pointer should be released and re-positioned at the most accessible number, equal to the number of starts. As each new start is required, select 'spindle disengage' at the workhead, rotating the faceplate by hand until the next identical number is aligned with the pointer. Re-select 'spindle engage'.

13. For all other divisions the faceplate degree graduations should be utilised in conjunction with the adjacent vernier scale. The start angle $= \frac{360}{\text{No. of starts.}}$

14. Component indexing is achieved by releasing the three faceplate securing screws and re-positioning the faceplate to the required

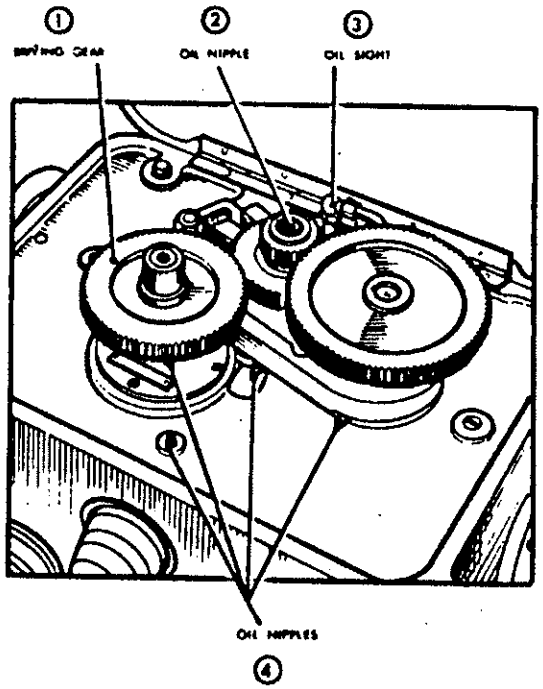


Fig. 4 Pitch change gears mounted for R.H. work

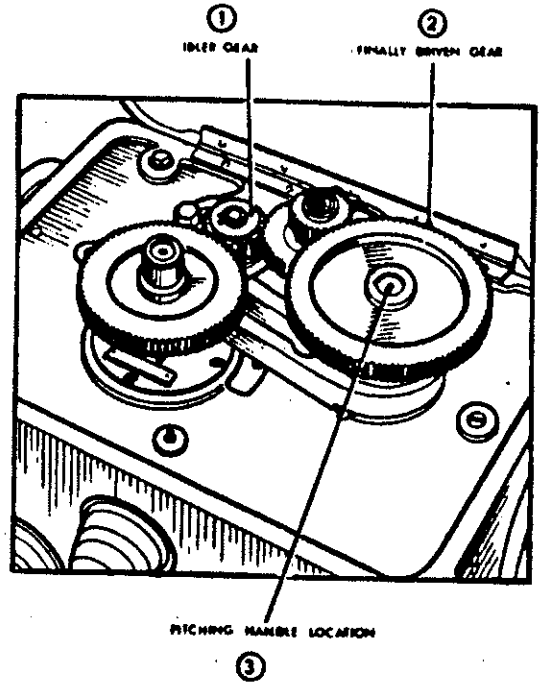


Fig. 5 Pitch change gears mounted for L.H. work

position. Tighten the three securing screws before the commencement of operations.

15. For chuck or collet mounted work, the faceplate together with the front drive plate should be removed to reveal the chuck mounting register.

16. A collet drawbar handwheel is located at the left of the workhead casting, this facilitates adjustment and release of spindle collets.

TAPER CONTROL

17. Taper is controlled by the knurled adjustment knob Fig. 1 (8). Prior to operation, the taper lock Fig. 1 (7) should be released. A graduated plate adjacent to the taper control facilitates setting the worktable.

18. The pitch correction scale (Fig. 7) is employed when setting the slide for work requiring taper threads upright to the work axis. The scale indicates the amount of correction to be added to or

variable relief of between 0 and 0.2 in. (0 and 5 mm).

29. The 'land control' Fig. 8 (1) rotates the cam (3) preventing the relief cam follower from completely following the cam form. When the periphery of the land control cam (3) extends beyond that of the relief cam (2) the follower (4) will trace the path of the land control cam, grinding wheel infeed will consequently be delayed. Infeed commences as the follower leaves the land control cam and starts to follow the relief cam.

30. When grinding non-relieved work the flute change gears should be removed and the land control set to position the follower clear of the cam.

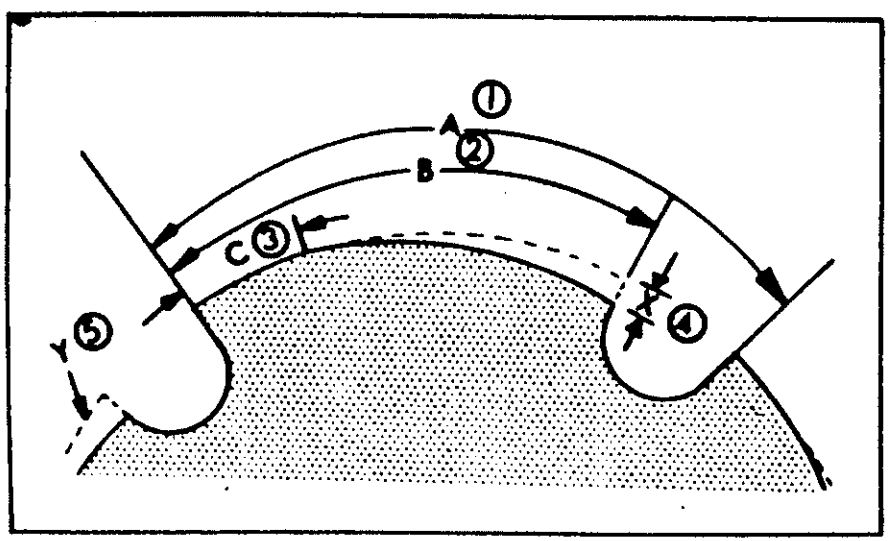


Fig. 9 Relief and land elements

FITTING THE RELIEF CAM

31. Remove the finally driven flute change gear 'D' Fig. 10. Rotate the knob (1) Fig. 8 fully clockwise (turning the land control cam anti-clockwise). It will be seen that the relief cam is engraved L.H. and R.H. on opposing sides, mount the cam with the relevant marking outermost. Refit the change gear 'D' above and return the cam follower either to its original position or set in accordance with the required amount of 'land.'

SETTING THE DEPTH OF RELIEF

32. Release the pivot nut Fig. 8 (6) and set the required amount of relief utilising the control knob (5), secure the pivot locknut after setting.

AMOUNT OF LAND SETTING

33. Release the lockscrew Fig. 8 (17) and turn the control knob (1) clockwise to its fullest extent. Adjust the knob to the nearest '0' setting (giving no land). Turn the control knob (1) in the opposite direction to effect the required amount of land.

NOTE: One complete revolution of the control knob will provide an amount of land equal to one eighth of the total possible, equivalent to 270° of cam rotation (Fig. 9). Tighten the lockscrew Fig. 8 (17).

CHANGE GEARS FOR STRAIGHT FLUTES

34. These are selected so that the wheelhead automatically advances to grind the relief an equal number of times per work revolution as there are flutes. Gear trains may be simple or compound. Instruction plates for spiral and straight flutes are affixed to the gearbox cover.

CHANGE GEARS FOR SPIRAL FLUTES

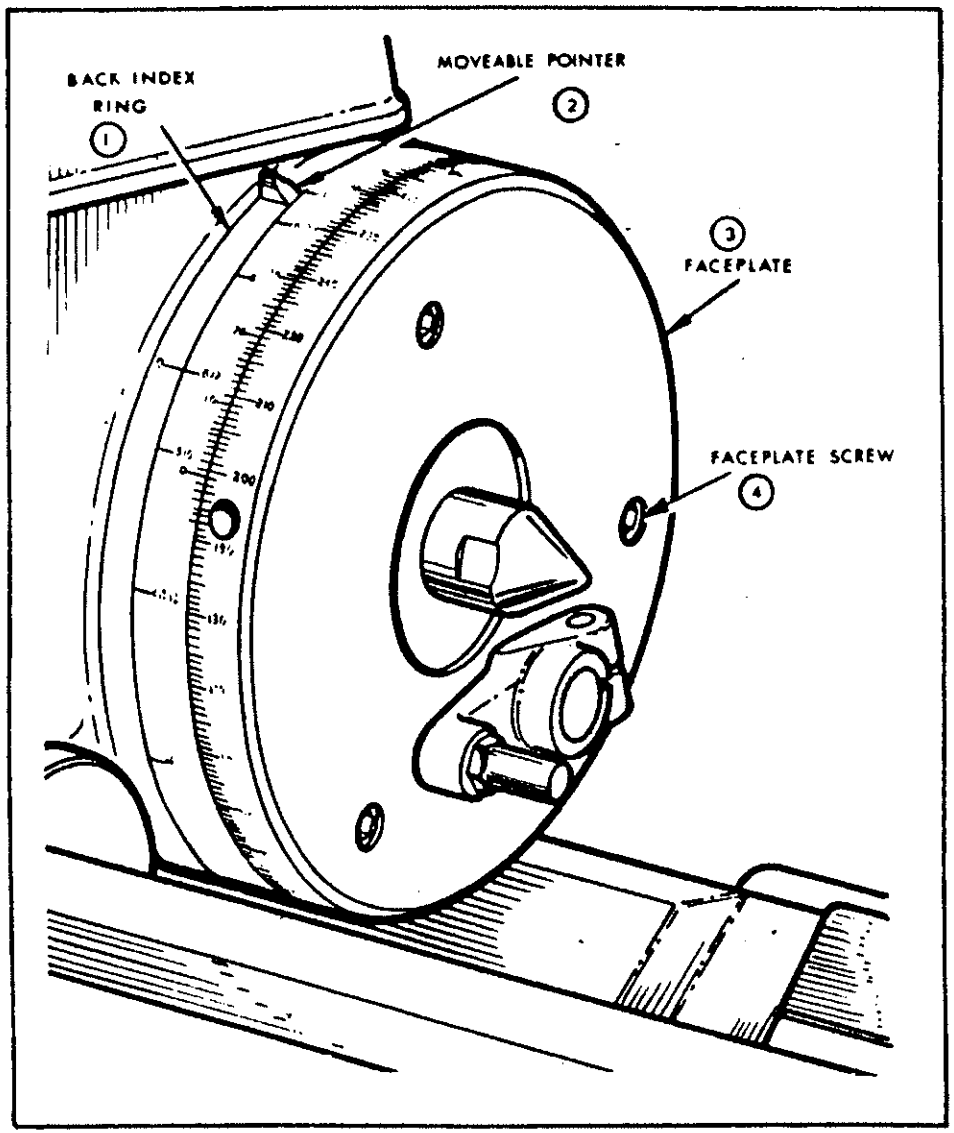


Fig. 6 Faceplate assembly

subtracted from the nominal pitch; the actual correction being made using the pitch corrector control.

19. The side-cut control Fig. 1 (12) allows the workslide to be displaced axially, permitting the alignment of a pre-roughed workpiece with the grinding wheel rib/s.

PITCH CORRECTOR CONTROL

20. The pitch correction control Fig. 1 (11) permits minor errors of pitch to be eliminated and also permits threads to be ground with a slightly longer or shorter pitch than normal. Clockwise rotation of the control knob will increase, and anti-clockwise rotation decrease the component pitch.

NOTE: Prior to operation, the knurled lockscrew situated below the control knob must be released, also the hexagon sine bar locknut adjacent to the control knob. Both must be locked between the commencement of grinding operations.

TAILSTOCK

21. The tailstock Fig. 1 (2) is located on the workslide and retained in the desired operating position by two 'tee' bolts and securing hexagon nuts. A lever on the top of the unit extends or retracts the barrel. A compression spring retains the barrel centre in contact with the workpiece; a barrel stop is incorporated which will override the spring should the possibility occur of the barrel spring being displaced by a heavy component. When mounting the component the stop screw should be fully tightened and then released half a turn to allow for local expansion

GEARBOX

22. The gearbox and associate controls is located at the rear of the hinged cover at the front of the machine base (Fig. 8); the gearbox motor being controlled by the traverse control lever.

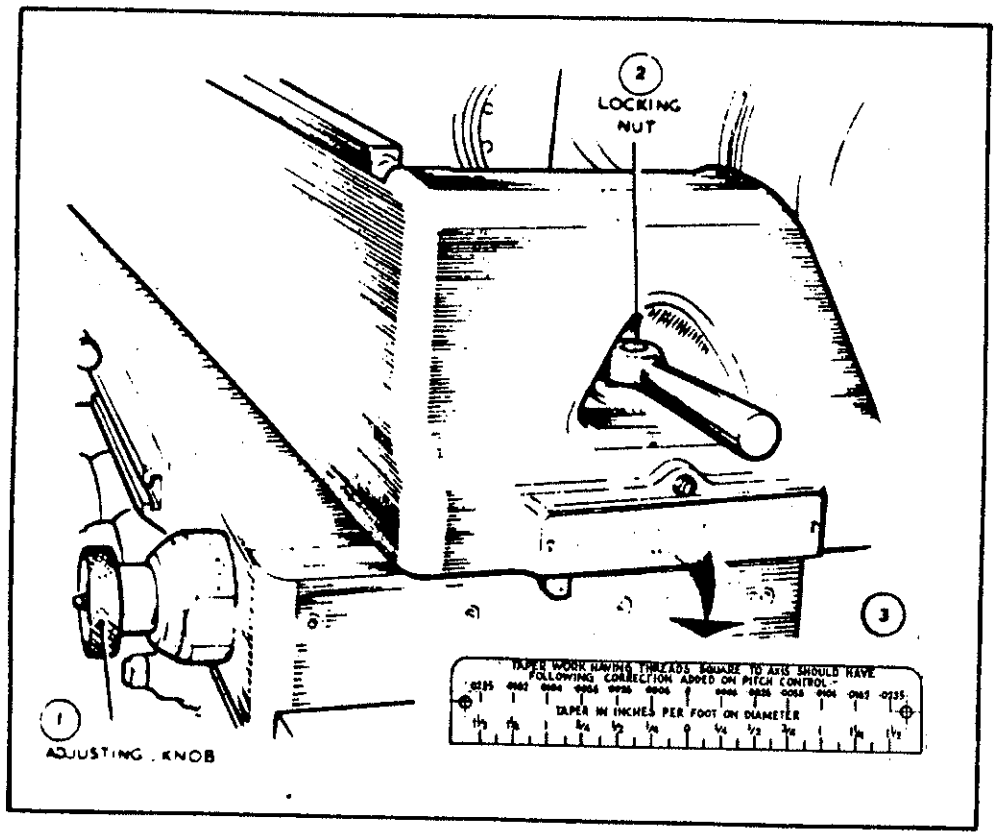


Fig. 7 Taper control

WORKSPEED PICK-OFF GEARS

23. Workspeed is controlled by mounting pick-off gears (see Fig. 8), the appropriate gears and resultant workspeeds are tabulated on the adjacent data plate.

24. The workspeed range is selected by the lever Fig. 8 (11), 'high speed' being engaged when the lever is in the upper position. Return speeds can be the same as forward speeds but alternative return speeds of 25.4 and 81.0 r.p.m. may be selected from the machine control station.

25. Selecting the 'high/low' range lever at 'low range' actuates micro switches which nullify accidental selection of the 81.0 r.p.m. return speed. The switches also effect a drive delay until the mechanical clutch is fully engaged.

IMPORTANT; For leads over 1 in. (25 mm) 'Low Range' and 'Low Ratio' should be selected.

RELIEF MECHANISM.

26. The relief mechanism is incorporated partly in the gearbox and partly in the feed unit, all settings being made on the gearbox. Settings are carried out by the selection of flute change gears Fig. 8 (13) and by adjustment of the relief control (5) and 'amount of land' control (1).

27. Flute change gears are mounted in either simple or compound train, to control the revolution frequency of the relief cam per revolution of the workpiece. i.e. the number of flutes. Movement of the relief cam follower imparts vertical reciprocating motion to the relief arm Fig. 8 (7), this action being transmitted to the feed mechanism effects a similar advance and retard action to the grinding wheel.

28. The depth of the relief is governed by the position of the relief arm pivot on the cam follower bracket, adjustments facilitate a

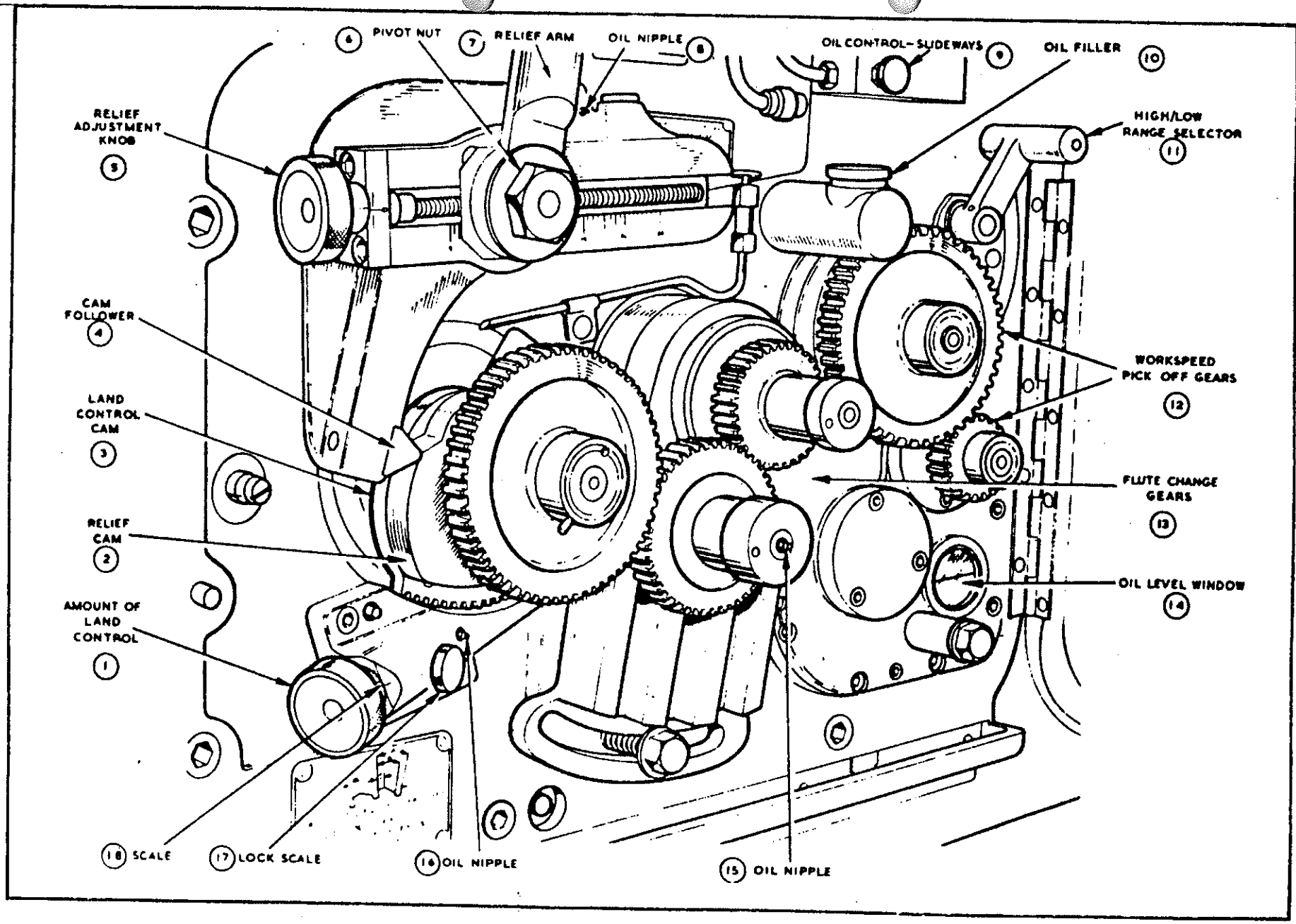


Fig. 8 Gearbox

35. The spiral flute formulae may be expressed as follows:

L = Lead of flutes

$P = \frac{\text{T.P.I.}}{\text{No. of starts}}$

N = No. of flutes

T = Lead of thread = pitch x No. of starts

E = Effective dia. of thread

X = Helix angle of flutes

Gears $\frac{A}{B} \times \frac{C}{D} = \frac{N}{4} \left(1 \pm \frac{T}{L}\right)$

$\frac{T}{L}$ is positive when thread and flute hands are opposite.

(R.H. thread with L.H. spiral)

(L.H. thread with R.H. spiral)

$\frac{T}{L}$ is negative when thread and flute hands are alike.

(R.H. thread R.H. spiral)

(L.H. thread L.H. spiral)

L is calculated from the formulae $L = E \frac{\pi}{\tan. X}$

36. Example: T.P.I. = 8 R.H.
No. of starts = 3
No. of flutes = 4
Helix angle of flutes = 10°L.H.
Outside diameter = 1.2501n.
Effective diameter = 1.1701n.

Lead $L = E \frac{\pi}{\tan. X}$

$L = \frac{1.170 \times 3.1416}{\tan 10^\circ}$

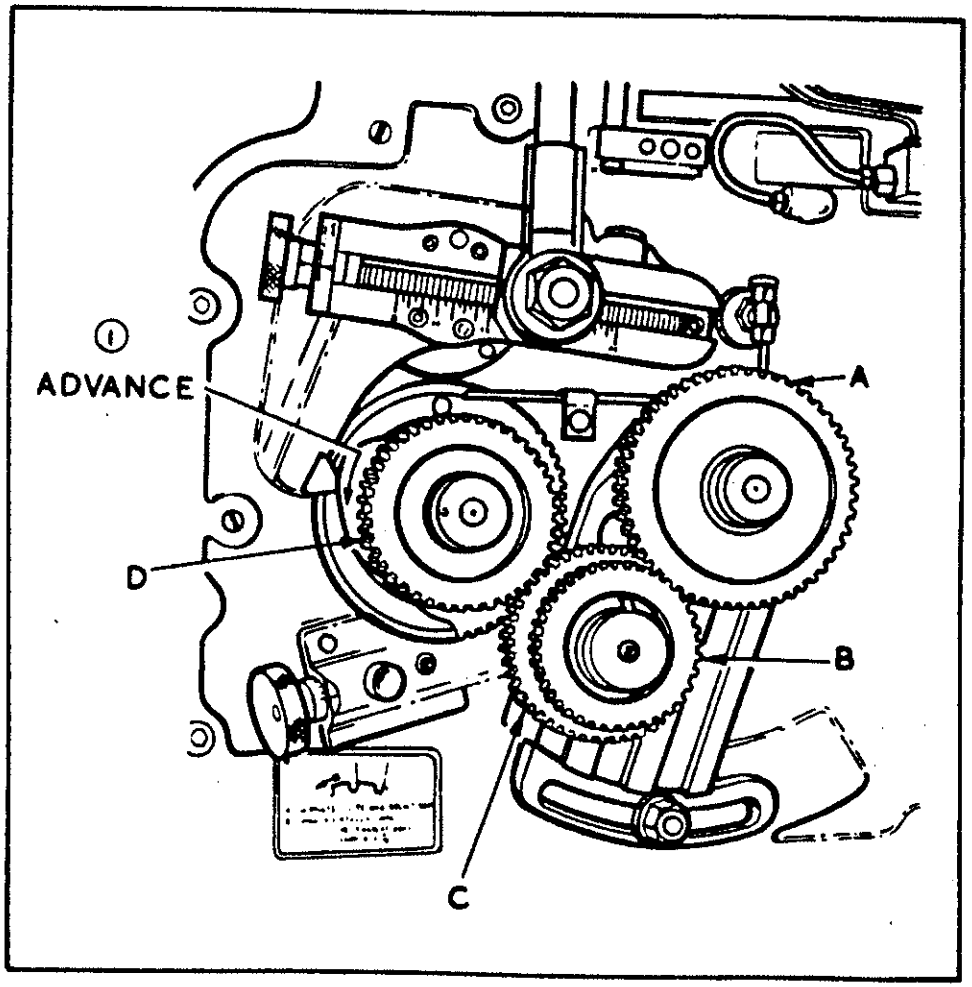


Fig. 10 Flute change gears compound train

$$L = \frac{1.170 \times 3.1416}{0.1763270}$$

$$L = 20.845721\text{in.}$$

$$\frac{A}{B} \times \frac{C}{D} = \frac{L.P.M. \pm N}{4\ L.P.} \quad \text{where}$$

$L = 20.84572$
$P = 2.66667$
$M = 4$ and is positive

$$= \frac{(20.84572 \times 2.66667 \times 4) + 4}{4 \times 20.84572 \times 2.66667}$$

$$= 1.0179832.$$

Suitable change gears to give this ratio are $\frac{89}{45} \times \frac{35}{68}$.

37. Using this ratio and working back the actual lead is 20.863643. Compared with the required lead there is an error of 0.0179in. This will be sufficiently accurate for all practical purposes.

WHEELHEAD AND WHEELHEAD FEED

38. The wheelhead is roller mounted; manual traverse being effected by the handwheel at the front of the machine base. The adjustable ring at the rear of the handwheel incorporates a stop which may be set to limit the amount of wheelhead infeed. To set the stop release the two knurled screws at the front of the handwheel and adjust the scale until the required amount of wheelhead infeed is registered opposite the zero mark. Tighten the knurled screws.

SPINDLE DRIVE BELTS

39. When replacing the drive belts ensure that they are fitted correctly, the rounded ends of the links should correspond with the direction of belt rotation. Belt links should be removed as necessary to maintain a correct tension.

HELIX ANGLE SETTING

40. Release the four hexagon nuts at the rear of the wheelhead drum and operate the helix control wheel at the side of the wheelhead. Lock the four securing nuts. Helix angle charts will be found in section 'Z'.

WHEELHEAD 'RAPID THROWOUT' CONTROL

41. The wheelhead rapid throwout control fig. 1 (13) may be either manually or automatically operated. Automatic operation being effected by an adjustable trip, pre-set to depress the throwout plunger button on the top of the feed unit. The total amount of wheelhead retraction is 9/32in. (7.4 mm).

Note: Workslide reverse traverse can only be effected with the wheelhead in the retracted position.

WHEELHEAD 'RAPID ADVANCE' CONTROL

42. The rapid advance control lever fig. 1 (16) should be located in the raised position to effect a rapid advance of the wheelhead from the retracted to the grinding position.

MACHINE CONTROL STATION

43. All machine controls are conveniently grouped on a single control station (fig. 11) at the front of the machine base.

44. Wheelhead Switch

Attention: Prior to making switch selections the 'master stop' button must be depressed, after which the required selection can be made and the machine re-started by depressing the 'master start' button.

45. Workhead switch

L.H. or R.H. will require to be selected in accordance with the thread hand being ground.

Warning Switch selection must only be made in accordance with the pitch change gears mounted. Pitch change gear trains must contain an idler gear. Failure to comply with this instruction will result in serious damage to the machine.

46. 'External/Internal' Grinding Switch

To be selected in accordance with the type of grinding required, the selection determines the rotational direction of the grinding wheel. With 'External Grinding' selected the wheel will rotate in a clockwise direction viewed from the left hand side of the machine.

47. Auto-Return Switch

The auto-return switch will not be fitted unless the machine incorporates the automatic return feature when the switch will be set at either L.H. or R.H. to comply with the 'workhead' switch setting.

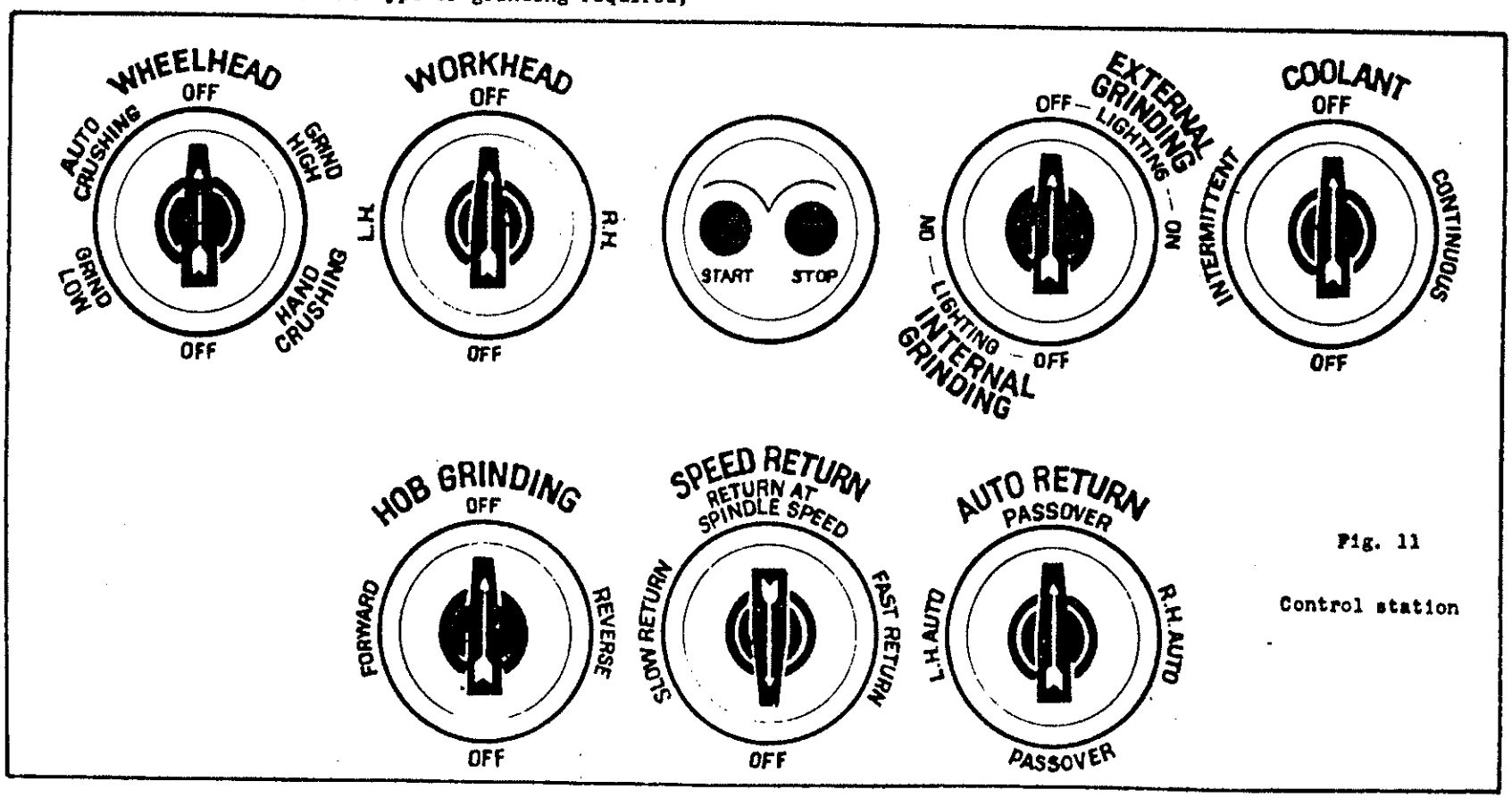


Fig. 11

Control station

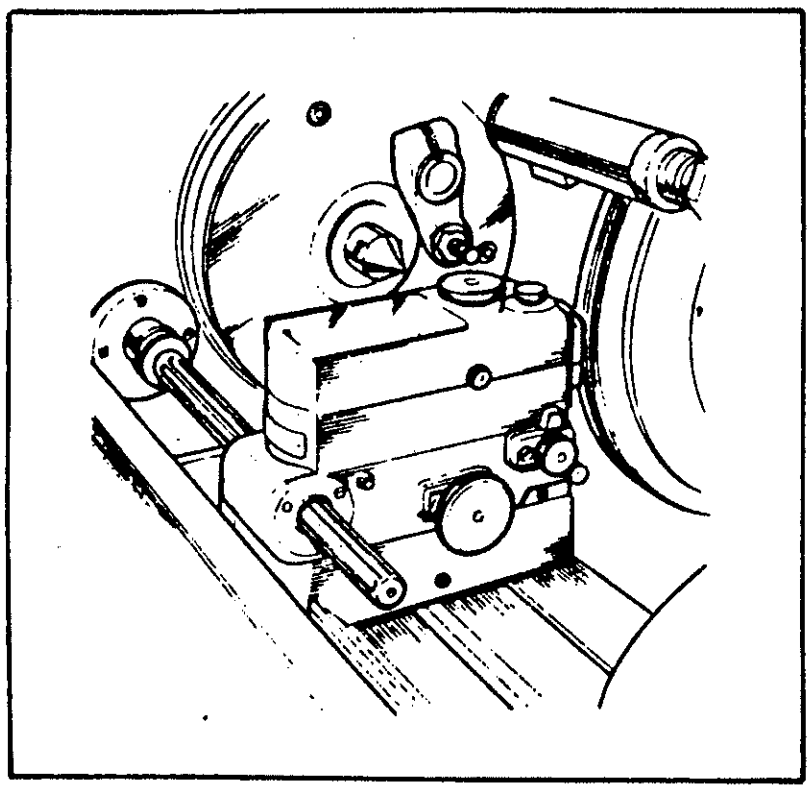


Fig. 1 35L multi-ribbed wheel dresser

35L. MULTI-RIBBED WHEEL DRESSER

INTRODUCTION

1. The unit is mounted on the machine workslide and actuated by a splined shaft which is inserted through the unit as shown on Fig. 1 and driven by a workhead shaft. The end of this workhead shaft is adjacent to the faceplate and should be protected by the special cap provided when the dresser is not in use.

2. Drive is transmitted to a cam in the dresser which imparts a reciprocating motion to a stylus secured to a diamond slide. A diamond is attached to the other end of this slide which is spring loaded to maintain cam and stylus contact. As the machine workslide traverses, the diamond reciprocates and dresses the wheel to the form determined by the selected cam and pitch change gears.

3. The dresser has three main parts; the base which is clamped to the machine workslide, the intermediate section and the top section. The intermediate section slides on the base and is controlled by a screw and a knob to enable a side-cutting motion to be imparted and also facilitates alignment of the diamond to the wheel form. The top section can pivot about the cam spindle by using the angular adjustment knob and is locked in position by the large knurled knob on the top of the dresser. This adjustment enables the wheel form to be dressed square to the wheel axis and should not be altered after setting.

CAM SELECTION

4. Each cam is engraved with a zero line indicating its crest, the

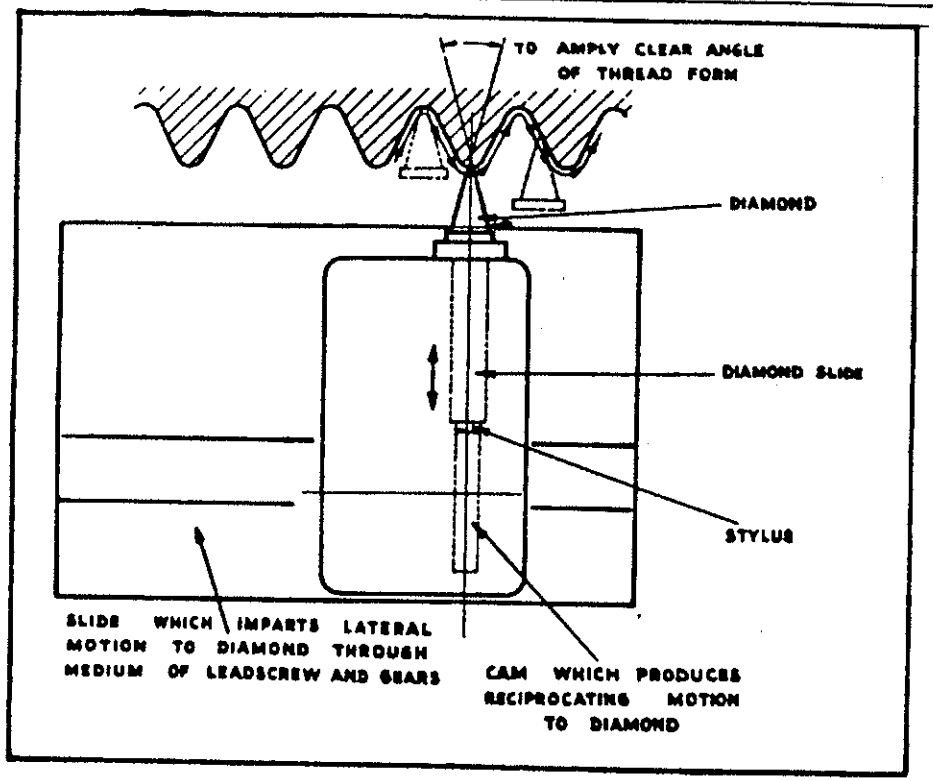


Fig. 2 Dresser Action

thread pitch produced, and the diamond radius required. A cam marked 4P x 0.005 in. denotes that the cam is to be used for 4 TPI and the radius of the diamond must be 0.005 in.

CAM MOUNTING

5. Fully tighten the stylus releasing screw and remove the inspection cover. Remove the nut and washer from the cam spindle. Thoroughly clean the cam bore and spindle and apply a thin film of light oil to each. Using only finger pressure, press the cam on to its seating, at the same time ensuring that the engraved markings are outermost. Fit and tighten the nut and washer; a light grip is sufficient. Release the stylus releasing screw to allow full travel of the slide and then replace the inspection cover.

CAM REMOVAL

6. Fully tighten the stylus releasing screw and remove the inspection cover. Remove the nut and washer from the cam spindle. Attach the special cam extractor by screwing the outer extractor screws into the cam holes and then turning the large central screw. Never use force.

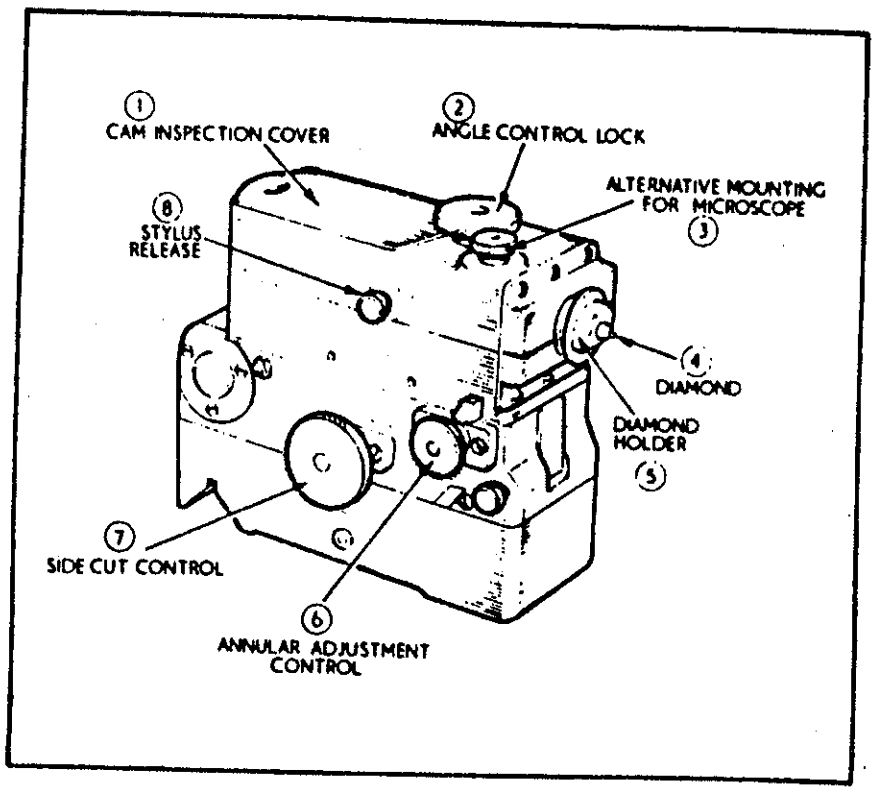


Fig. 3 35L multi-ribbed wheel dresser

DIAMONDS

7. Two types of diamond are used for wheel profiling: 'Vee' and 'Cone'. A 'Vee' diamond is used for removing the bulk of the wheel material and for finishing sharp 'Vee' profiles with radiused core and crest which were previously profiled with a 'Vee' diamond.

8. The diamond angle must be more acute than the required thread form angle. The angle and radius of a diamond is stated on its box.

9. 'Cone' and 'Vee' diamond holders and mounting differ. A 'Vee' diamond mounting has two slots, one of which must engage a pin in the holder; the life of the diamond can be doubled by repositioning so that the holder pin locates in the opposite slot. A'Cone' diamond had no fixed location in its holder and, as the diamond is spherically pointed, it may be progressively repositioned through 360°.

10. Two designs of 'Vee' diamonds can be used, one of which permits the the mount to be cleared away at the sides of the diamond and thus allow it to profile a form whose depth exceeds the exposure of the diamond from its mounting. The other design is for small diamond and the exposure of the diamond from the mount governs the maximum depth of form that can be profiled. When ordering diamonds, always state the maximum pitch of the work.

11. The accuracy of the thread forms produced depends upon the accuracy of the diamond radius. No 'Cone' diamond is perfectly spherical, so the diamond must first be checked by optical projection on to a large layout to ascertain the most accurate radius, and then mounted on the dresser in the same attitude. When selecting a 'Cone' diamond ensure that the length of the diamond is greater than the depth of the form to be produced.

12. The effect of incorrectly radiused diamonds is shown in Fig. 4. Whilst 'a' and 'b' are unsatisfactory, condition 'c', although incorrect, produces a large effective diameter which can be adjusted by limited disposition of the wheelhead helix, or by side-cutting as explained in para. 16.

WHEEL DRESSING

13. (1) Select balance and mount a suitable wheel. (See Section G.)

(2) True the wheel periphery with a keen diamond in a Type 11038 tailstock mounted truer.

(3) Set the machine for grinding right hand threads of the required T.P.I.

(4) Incline the wheel to the appropriate helix angle.

(5) Mount the selected cam in the dresser and locate the dresser on the machine.

(6) Locate a 'Vee' diamond in the dresser, set it to the required hand (see Fig. 6) according to the helix inclination and then lock with the grubscrew (F).

14. Dressing with a 0.005 in. (.127 mm) radius diamond and with the wheel rotating at 2,000 to 2,500 feet per minute is in three stages:

15. <u>Stage 1 - Plunge Cutting with a 'Vee' Diamond</u>

NOTE: Plunge cutting should be deliberate, continuous and not too slow in feed. The diamond must always cut, never rub, and be withdrawn immediately maximum depth is reached.

(1) Remove the cam cover and traverse the machine slide until the diamond is positioned approximately as shown in Fig. 5, and the cam zero line coincides with the stylus. Replace the cam cover. Set the faceplate pointer to a convenient position on the engraved scale. Turn the side cut control to position the diamond exactly as shown.

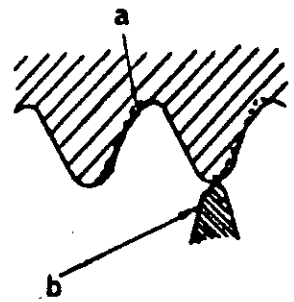
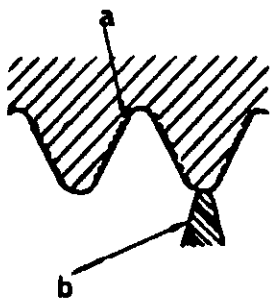
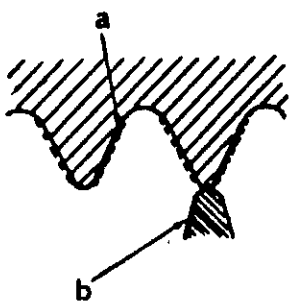


Fig. 4 ' (a) Effect of unsymmetrical diamond radius



(b) Effect of undersized diamond radius



(c) Effect of oversized diamond radius

Fig. 5

Correct Diamond to Wheel Relationship at Commencement of Plunge Cut

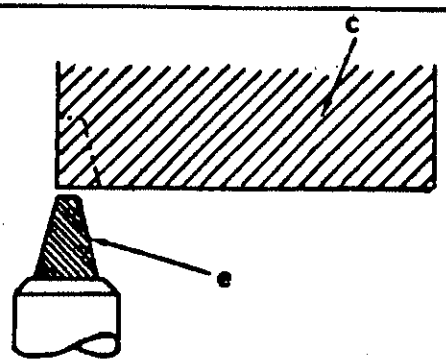
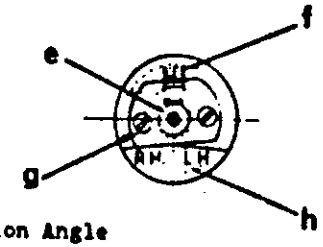
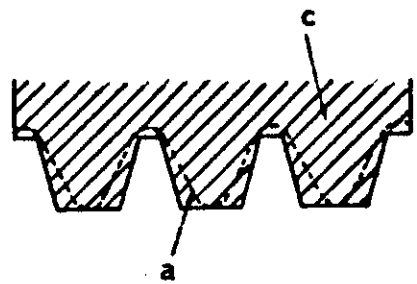


Fig. 6



'Vee' Diamond in Holder. Inclination Angle may be L.H. or R.H.

Fig. 7



Wheel Form after Plunge Cutting with a 'Vee' Diamond

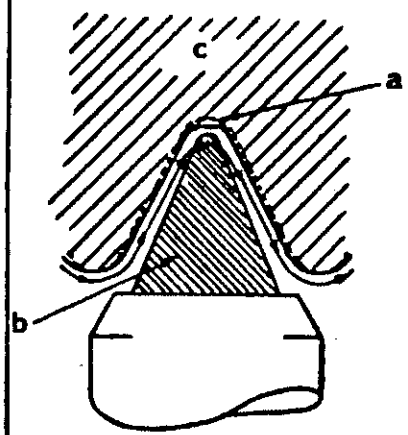


Fig. 8

Location of Diamond in Rough Profiled Form.

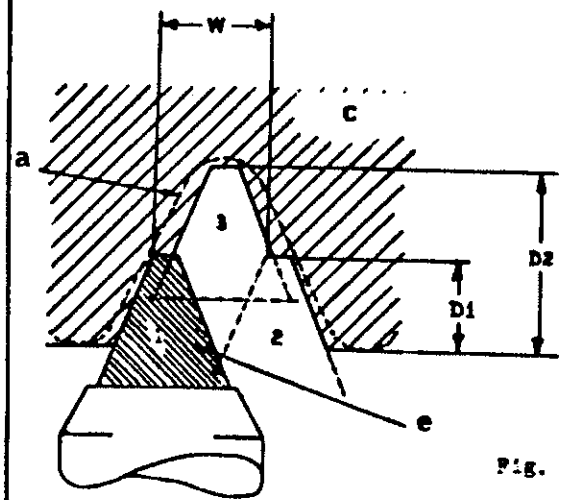


Fig. 9

Plunge Cut Profiling Sequence

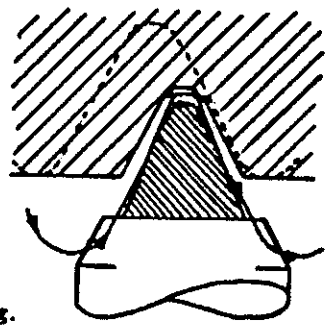
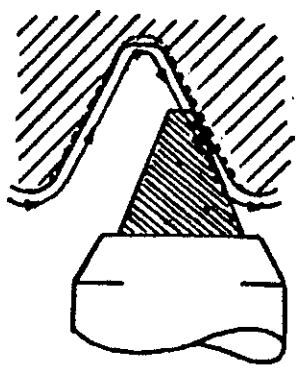


Fig. 10

Method of Profiling by Side Cutting.
(a) First Rough Profiling Cut

(b) Intermediate Rough Profiling Cut.
Diamond Retarded by Side Cut Control.



(c) Final Rough Profiling Cut.

(2) With the wheel rotating and the machine slide stationary, turn the feed handwheel until the diamond touches the wheel and then supply maximum continuous coolant.

(3) For 11 T.P.I. and finer pitches feed into the single thread depth; for pitches coarser than 11 T.P.I. feed into the maximum depth of 0.060 in. (1.525 mm).

CAUTION: If these depths are exceeded the diamond will be wrenched from its mounting.

(4) Lock the feed handwheel stop in this position and then retard the wheel by one turn of the feed handwheel. Never employ any procedure other than this.

(5) Rotate the faceplate one revolution and re-align the selected faceplate scale mark to the pointer. The machine slide will traverse one pitch.

(6) Feed in to the specified depth, retard the wheel by one turn of the handwheel, rotate the faceplate, align the scale mark and repeat this operation across the full wheel face.

(7) Retard the wheel and reverse the slide traverse until the diamond is to the left of the grinding wheel.

(8) Fig. 7 shows that after plunge cutting with a 'Vee' diamond the angle of the grooves formed is narrower than ultimately required. Stage 2 increases the groove width with the same diamond.

(9) For extra coarse pitches determine from optical projection: the flat of the diamond, D1, D2 and W as shown in Fig. 9. Dress the wheel in a series of plunge cuts using normal plunge cut procedure. Infeed to D1, note the side cut index and divide out across the wheel face. At the same infeed figure, side cut an amount equal to 'W' and repeat the plunge cut at position 2. Reverse the side cut by half of 'W' and infeed to D2 to complete the rough profile as shown at pos. 3. The wheel may now be profiled with a 'Vee' diamond.

16. Stage 2 - Profiling with a 'Vee' diamond

(1) Align the cam zero line to the stylus and the diamond with the left hand groove of the wheel and advance the grinding wheel until the diamond is within 0.010 in. (.25 mm) of maximum depth.

CAUTION: If this depth is exceeded the diamond will be excessively stressed. Correction of sharp grooves to a Whitworth profile must be carried out in small cutting increments.

(2) For 11 T.P.I. and finer pitches, traverse the diamond across the wheel face at this depth and on subsequent passes advance the wheel in 0.003 in. (.076 mm) increments until the handwheel stop is reached. A workspeed of approximately 3 r.p.m. is recommended.

(3) For pitches coarser than 11 T.P.I. increments may be more than 0.003 in. (.076 mm) but the side cut control must be employed to force the diamond to make a heavier cut on its forward motion. The ratio between the infeed and side cut must be 2:1 e.g. with a 0.006 in. (.1524 mm) infeed, retard the machine slide traverse by 0.003 in. (.076 mm) using the side cut control. Make successive passes until the required depth is reached. Refer to Fig. 10.

17. Stage 3 - Finish Profiling with a 'Cone' Diamond

(1) With the wheel rotating, traverse the diamond until it is positioned as shown in Fig.8, with the cam zero line coinciding with the stylus. View the diamond through the microscope and turn the side cut control to centralise the diamond to the groove but do not allow the diamond to contact the wheel.

(2) Make the minimum number of cuts not exceeding 0.003 in. (.076 mm) until the diamond traces a complete profile. The amount to be removed depends upon the condition of the roughing diamond. Check the diamond by optical projection for wear; if the diamond radius is retained the wheel is ready for use.

DRESSING FINE WHITWORTH AND BA THREADS

18. For these thread forms a factorized wheel is recommended. Determine from optical projection: the flat of the diamond 'D1', 'D2' and 'S' as shown in Fig. 11. Infeeding to D1 dress the wheel in a series of plunge cuts using normal plunge cut procedure but producing grooves at every second revolution of the workhead, i.e. at twice the work pitch. Retard the diamond, by means of the side cut control, an amount equal to 'S' then take a secondary plunge cut to the depth D2, as shown in Fig. 12. Finally profile as detailed in para. 17.

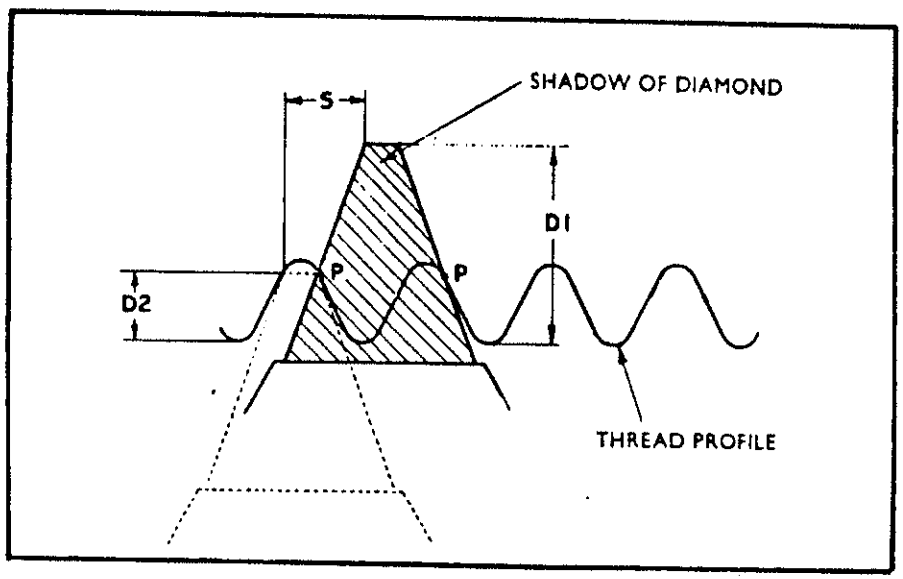


Fig. 11 Vee diamond optically projected

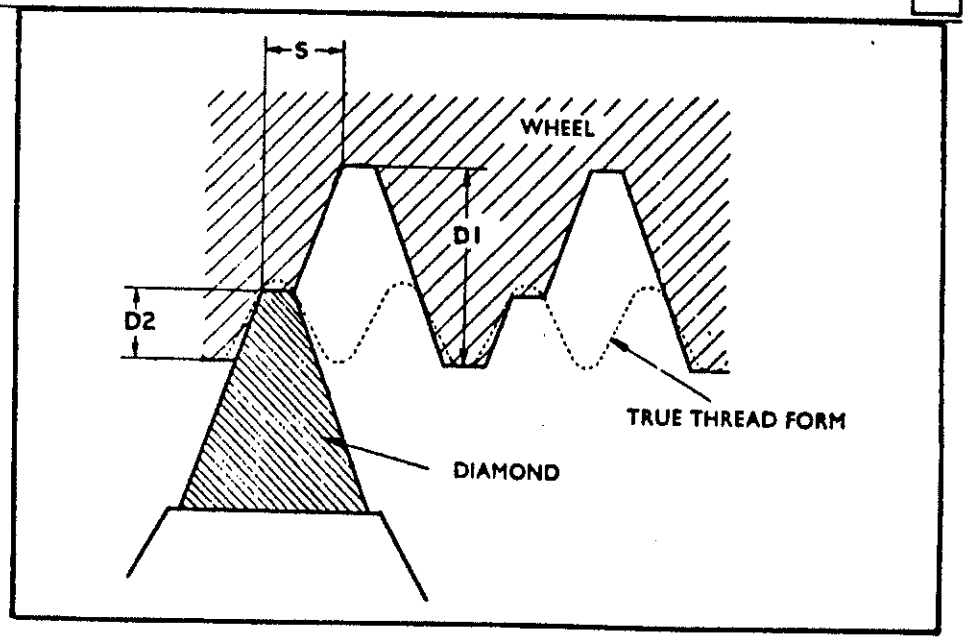


Fig. 12 Wheel after primary and secondary plunge cuts

METRIC, U.S.S. AND EFFECTIVE 'NOT GO' GAUGE FORMS

19. As the core radius of these threads is specified as 'less than a certain figure', a fairly sharp 'Vee' diamond will form the wheel required.

20. For fine threads a 'factored' wheel is used, i.e. a wheel formed to a multiple of the basic pitch required. For example, to produce a 40 T.P.I. sharp vee thread: mount the necessary change gears on the machine for 20 T.P.I. and, with the aid of a 20 T.P.I. sharp vee cam and a strong roughing diamond, plunge cut the wheel to a depth equal to twice the required pitch. Using a sharp 'Vee' diamond profile the correct thread form sufficient to clear the required depth of the component (Fig. 13). For grinding operations remove the 20 T.P.I. change gears and mount gears for 40 T.P.I.

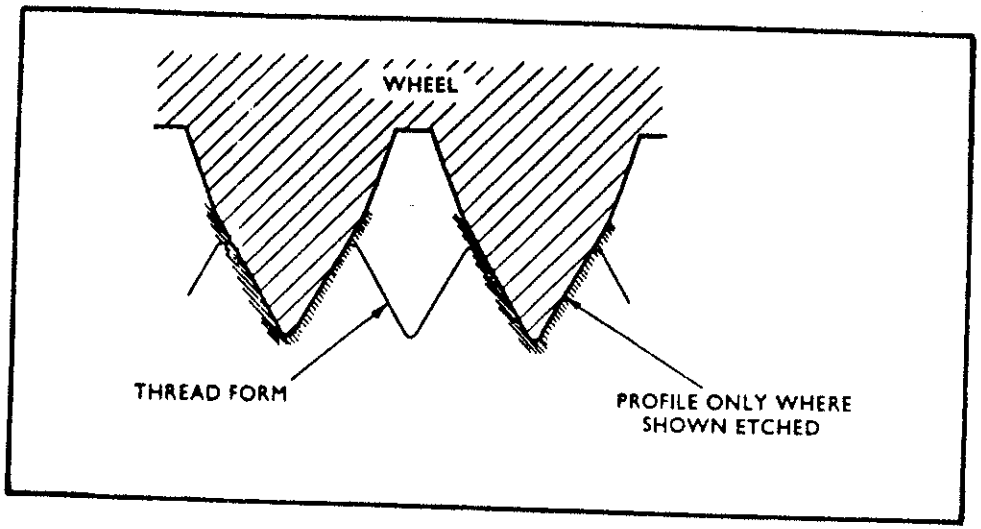


Fig. 13 Factored wheel

MULTIPLE START THREADS

21. These threads can be formed without dividing out through the change gears, e.g. a 20 T.P.I. Whit. form thread, 4 start lead; Gear the machine for 20 T.P.I. and dress the wheel for this pitch; the helix angle of the wheelhead must be set for the helix angle of the required lead, that is 5 T.P.I., and not of the pitch. Remove the change gears and mount gears suitable for the lead, that is 5 T.P.I. The machine is now ready to produce the required thread.

BUTTRESS THREADS

22. A special diamond holder is used for Buttress threads; the steep angle of the thread form should be at least $4\frac{1}{2}^{\circ}$. A truncated thread will require factoring where the crest truncation is such that there is no clearance for a standard .007 in. flat 'Vee' diamond.

TAPER THREADS

23. For taper thread forms upright to the work axis a special cam should be fitted to the dresser and the wheel dressed with the slide set to the taper angle. If a special cam is not available, a standard cam can be fitted to the dresser; the slide set to the taper angle and the upper section of the dresser swivelled to the corrective angle. To swivel the upper section of the dresser, slacken the knurled locknut on the top of the dresser, turn the angular adjustment control knob on the side of the dresser (see Fig.3) and then lock the locknut. Fig. 14 shows the correction angle which is 'E' plus 'A' and is calculated as follows.

Angle 'A' = Angle dresser is swung over from the vertical bisector of thread angle.
Angle 'B' = 90° (Flank angle + Angle 'E')
Angle 'C' = Included angle of thread
Angle 'D' = Flank Angle - Angle 'E'
Angle 'E' = Half included Taper Angle of work

Angle 'A' = The angle whose Tangent is

$$\left(\frac{\text{Sin C}}{2 \text{ Sin B Cos D}} - \text{Tan D} \right) - \text{E}$$

Example: Thread 11 T.P.I. B.S.P.
Taper 1 in 16 or $\frac{1}{8}$ in. per foot
Thus we know:
Angle 'C' = 55°
Angle 'E' = $1^{\circ}\,47'$
Angle 'B' = $90^{\circ} - (27^{\circ}30' + 1^{\circ}47') = 60^{\circ}43'$
Angle 'D' = $27^{\circ}30' - 1^{\circ}47' = 25^{\circ}43'$
Angle 'A' = The angle whose Tangent is

$$\left(\frac{\text{Sin } 55^{\circ}}{2 \text{ Sin } 60^{\circ}43' \text{ Cos } 25^{\circ}43'} - \text{Tan } 25^{\circ}43' \right) - 1^{\circ}47'$$

$= 2^{\circ}16' - 1^{\circ}47' = 0^{\circ}29'$

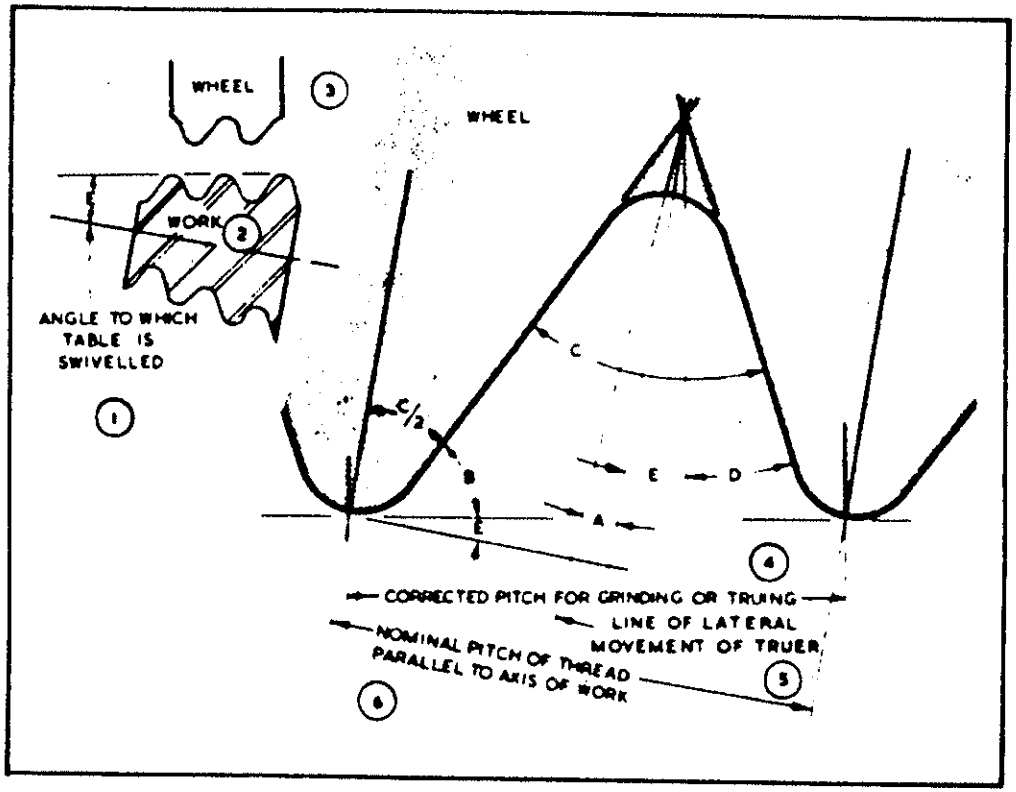


Fig. 14 Dresser angle calculating formula (Taper Threads)

24. Taper thread forms upright to the cone can be dressed when a standard cam is fitted to the dresser and with the slide set parallel but this method is suitable only for small quantity production because the slide must be reset to the taper angle for grinding after each dressing operation. Special cams are available to enable dressing and grinding with the slide set to the taper angle.

NOTE: When ordering special cams for taper threads always state whether the form is upright to the work axis or upright to the cone and on which machine the dresser is to be used.

CONTROL OF A 'CONE' DIAMOND RADIUS

25. The wheel form must be such that the effective diameter of the resultant component is the largest element. To produce this effect either use a slightly larger radiused diamond than standard or, after dressing by the normal procedure, take a further cut with the diamond at the previous infeed figure but retarded towards the forward motion by side cut control. The advantage obtainable by the resultant wheel profile allows the effective diameter of the work to be reduced to a nominal element by an appropriate adjustment of the side cut control: a slight deviation from the helix angle setting will produce a similar effect.

LMA MULTI-RIBBED WHEEL DRESSER.

GENERAL

26. The LMA Multi-Ribbed Wheel Dresser is mounted between the machine centres and secured by an adjustable jack, a spirit level in the top of the dresser facilitates levelling. Carrier drive is transmitted to the dresser cam housed in the body of the unit, cam rotation imparting a reciprocating action to the diamond slide. The slide is spring loaded to maintain the dresser stylus in contact with the operating cam. As the worktable is traversed, the diamond, influenced by the rotation of the cam will be caused to reciprocate, imparting the form to the wheel.

CAM SELECTION (SEE PARAGRAPH 3)

CAM MOUNTING

27. Tighten the stylus knob (Fig. 15) and remove the circular cam inspection cover (turning the cover through 90°). Remove the cam retaining nut and capwasher from the mounting spindle. Ensure that the cam spindle and bore of the selected cam are thoroughly clean, and apply light lubrication to both mating surfaces. Mount the cam (use light finger pressure) ensure that the engraved markings are outermost. Replace the capwasher, cam re-

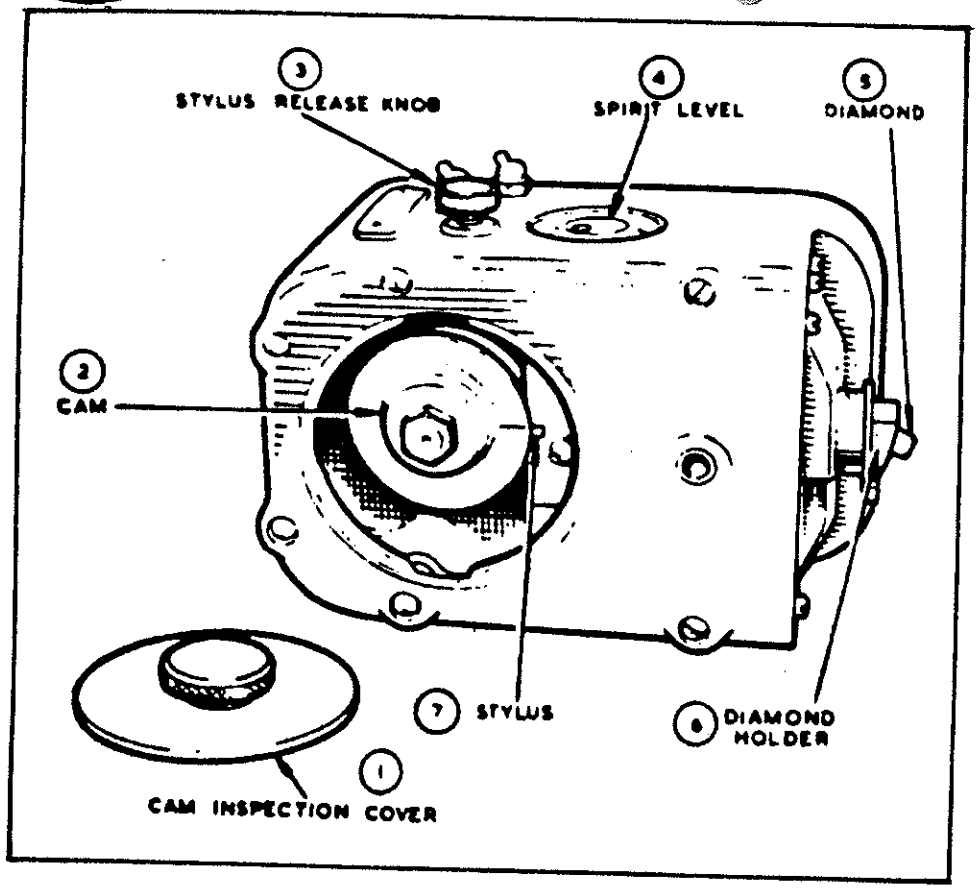


Fig. 15 LMA Multi-ribbed wheel dresser

taining nut and inspection cover. Release the stylus retaining screw.

CAM REMOVAL (SEE PARAGRAPH 6)

DIAMONDS (SEE PARAGRAPH 7)

WHEEL DRESSING (SEE PARAGRAPH 13)

DRESSING WITH A .005 in. RADIUSED DIAMOND IN THREE STAGES (SEE PARAGRAPH 14)

DRESSER MAINTENANCE

28. Treated with reasonable care and regularly serviced the unit will give many years of trouble free service. Should inaccuracies occur after extensive usage the unit should be returned to the manufacturer for rectification.

29. The cam retaining nut may be replaced by one of standard pattern, provided that the face is first trued to square on a screwed mandrel. The cam cover should always be in place when dressing, injurious matter entering the unit will be detrimental to its correct functioning. When worn the dresser stylus may only be replaced with one supplied by the dresser manufacturer, the stylus being of convex form to eliminate wear on the cam periphery which is concave in form.

NOTES ON DIAMONDS

30. A copious supply of coolant must always be maintained when plunging or profiling. Excessive heat generated at the point of contact of the diamond will cause premature wear.
Wheel speed for dressing should be as low as is compatible with good cutting.
Excessive workspeeds cause rapid wear of diamonds.
Always remove the bulk of material from the wheel with a keen 'Vee' diamond. A dull, worn 'Vee' diamond may be used for coarse or open structure wheels but not for close grain structures.
Remember that when profiling, the better cutting action of the diamond is on its forward motion and the largest possible amount of material should be removed on this motion.
Always use a diamond of sufficient weight and working depth in comparison with the thread form to be produced.
Never use a diamond for plunge cutting in such a manner that the wheel will grind the diamond mounting. Ensure that the 'Cone'

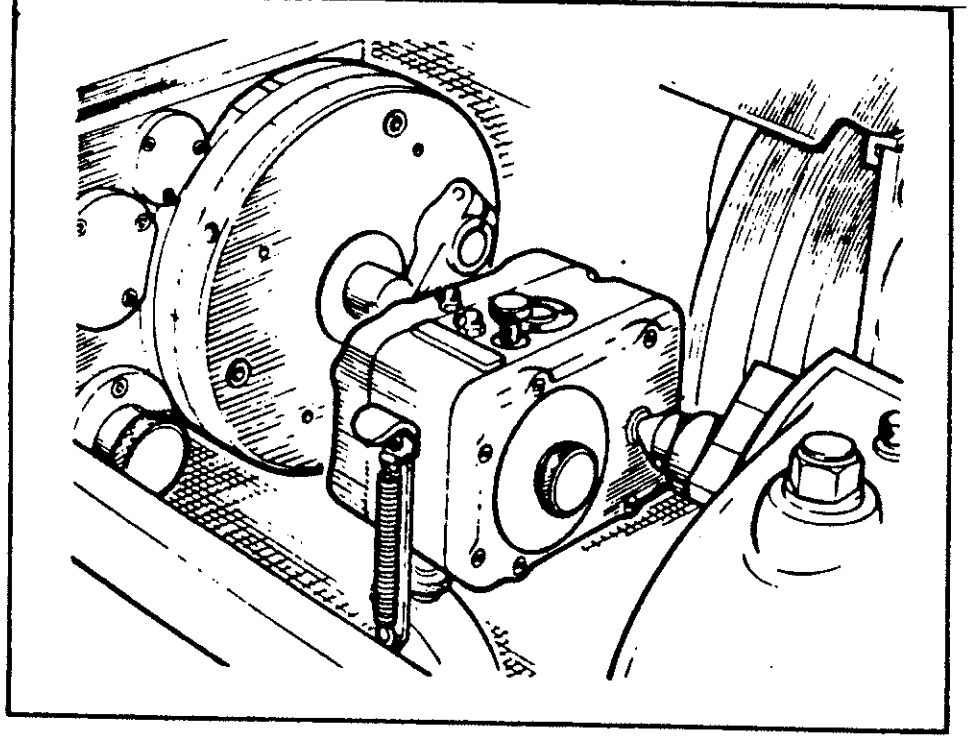


Fig. 16 LMA Dresser mounted between centres

diamond is large enough to clear the required depth of thread. Examine both types of diamond frequently. When the 'Vee' diamond is worn in one place reverse it in its holder.

Rotate the 'Cone' diamonds in their holders before excessive wear takes place in one position and destroys all other radii obtainable on the spherical point. Always return diamonds for re-lapping before excessive wear occurs and thus avoid reducing the diamond life by excessive re-lapping.

When a 'Vee' diamond wears, extra strain is imposed on the 'Cone' diamond in removing the extra material. The 'Vee' diamond is not apparently the ideal tool form to precede a radiused 'Cone' tool but its flat nose design is stronger than a radiused type and it can therefore withstand greater loads. The 'Vee' diamond gradually develops a natural radius much stronger than the artificial radius of a 'Cone' diamond and the introduction of an intermediate 'Cone' diamond between the resultant wheel produced by the 'Vee' diamond and the application of the cone finisher is considered sound practice. For this purpose a 'Cone' diamond which has lost the great part of its accuracy for finishing but is not worn sufficient to warrant re-lapping can be employed.

Never use a 'Cone' diamond to produce a 'Sharp Vee' thread form.

Successive diamonds used in dressing must be re-located into the previous form produced. Always locate the diamond with a slight bias towards its forward stroke, thus ensuring that if a load is inadvertently applied there is less chance of the diamond breaking.

When plunge cutting or profiling, a harsh squeal from the wheel and/or signs of the profile crests crumbling indicates that the diamonds cutting action has been destroyed and a new diamond is required.

NOTES ON CAMS

CAMS FOR STANDARD WHITWORTH THREADS

31. These cams produce a thread from with a core that is 0.002 in. to 0.0004 in. below nominal. For Whitworth threads 3 to 26 T.P.I. inclusive a finishing 'Cone' diamond with a raius of 0.005 in. should be used after rough profiling with a 0.007 in. flat Standard 'Vee' diamond. A special dresser is available for threads having a greater depth than 3½ T.P.I.

32. There are two methods for dressing wheels with threads 27 T.P.I and finer. The recommended method is to factor the wheel. A 0.007 in. flat standard 'Vee' diamond should be used for roughing out the wheel prior to finish profiling with a 0.0025 in. radius 'Cone' tool. When an actual formed wheel is necessary it should first be rough-profiled with a 'Vee' diamond having a flat or 0.003 to 0.004 in.

CAMS WITH DEEP CONE FOR WHITWORTH AND BA THREADS

33. These cams have 0.002 in. extra depth and are principally designed for the grinding of crushing rollers for production work. The extra depth is in the cone and the form on the wheel crest has consequently a smaller radius than nominal. Deep core Cams are available as follows:

4 T.P.I. upwards has 0.002 in. extra depth giving 0.004 in. on Work Core Diameter.
OBA to 8 BA has 0.002 in. in extra depth giving 0.004 in. on Work Core Diameter.
9BA and finer has 0.001 in. extra depth giving 0.002 in. on Work Core Diameter.

CAMS FOR SYSTEM INTERNATIONAL THREADS

34. The range of S.I. threads is 0.75 mm to 6 mm pitches inclusive. The threads produced by the cams have a sharp crest and a core radius of 0.058 in. (1.423 mm) x Pitch, the rough and finish profiling being carried out by a 0.007 in. flat 'Vee' and a 0.005 in. radius 'Cone', respectively.

35. On pitches of 2 mm and above the cone of the wheel is made to clear the truncation by taking the crest on the cam to the theoretical Sharp Vee, thus permitting the 'Cone' to cover the full length of the flank. Fig. 13 shows that on pitches below 2 mm it is not possible to do this without using a smaller radius cone diamond, which, on large pitches is bad practice. Factoring is therefore necessary on pitches 0.75 mm to 1.75 mm inclusive, whilst actual forms are used on pitches of 2 mm and over.

36. The marking on the cam for a factored wheel is, for example: 2 mm for 1 mm S.I. x 0.005 in. This means that the pitch must be geared up for 2 mm pitch when dressing and changed to 1 mm pitch for grinding.

CAMS FOR METRIC 60° SHARP VEE THREAD

37. This thread has a sharp vee core and a truncated crest, the flat of the truncation being equal to P/8. The cams are made with a sharp vee crest and core. Pitches 0.4 mm to 1.75 mm inclusive are factored and above that are actual, a 0.007 in. flat standard 'Vee' diamond being used for both. If an actual wheel is required for pitches of less than 1.8 mm then a 'Vee' diamond with a special width of flat is required.

38. Cams are marked thus: .8 mm for .4 mm S.V.; 3.5 mm for 1.75 mm S.V.; and so on. The following cams may be used for both pitches: 1.8 mm for .9 mm up to and including 3.5 mm for 1.75 mm.

CAMS FOR 55° SHARP VEE THREADS

39. The range covers 4 T.P.I. to 30 T.P.I. inclusive. For 'Not Go' gauges, factoring may be necessary on the finer pitches.

CAMS FOR WHITWORTH THREAD FORM AND BA TAPS TO B.S.I. SPEC. 949 GRADE 1.

40. These cams are for grinding crushing rollers for ground thread tap production. The disposition of the thread proportions brings the Crest, Effective and Core to the minor figures, allowing the tolerance to the maximum diameters to be fully explored as the wheel wears.

Cams for: 6 T.P.I. to 18 T.P.I. inclusive operate with a 0.005in. radius 'Cone' diamond.
20 T.P.I. to 30 T.P.I. inclusive operate with a 0.0035 in. radius 'Cone' diamond.
30 T.P.I. operate with a 0.0025 in. radius 'Cone' diamond.
36 T.P.I. and finer operate with a 0.002 in. radius 'Cone' diamond.

0 BA and 1 BA operate with a 0.005 in. radius 'Cone' diamond.
2 BA and 4 BA operate with a 0.0035 radius 'Cone' diamond

CAMS FOR 60° SHARP VEE THREADS (ENGLISH PITCHES)

41. In this range all the American National Thread series are covered, from 4 T.P.I. to 100 T.P.I. Pitches 4 to 14 T.P.I. inclusive, are actual, finer pitches are factored. Cams 4P to 7P inclusive are for producing actual threads. Cams suitable for both actual and factores wheels are marked accordingly, e.g. 8P for 16P the second figure being that for the factored wheel. A 0.007 in. flat standard 'Vee' diamond is used.

CAMS FOR STANDARD BA THREADS

42. Cams are available for standard BA pitches 0 to 20 inclusive. As it is not advisable to grind a thread finer than 40 T.P.I. on these machines 4 BA is the finest thread in this series recommended. 0 to 3BA are finished with a 0.005 in. radius 'Cone' diamond, and 4 BA a 0.0025 in. radius 'Cone' diamond. These threads may be obtained with a Sharp 'Vee' Core and Crest by using a BA Sharp 'Vee' Cone.

EXTRA DEPTH CAMS

43. When producing wheel profiles for grinding crushing rollers, or where limits allow, cams can be supplied to produce an extra depth of 0.002 in. on the wheel from crest to core. The core diameter produced on the work will therefore be 0.004 in. smaller in relation to the major diameter.

STANDARD ADAPTORS

44. Adaptor for 'Vee' diamond tools ..... Ref. No. 396A
Adaptor for 'Cone' diamond tools ..... Ref. No. 396B
Clamp for adaptor ..... Ref. No. 397

MATRIX

Dressers Single Point Wheels

D

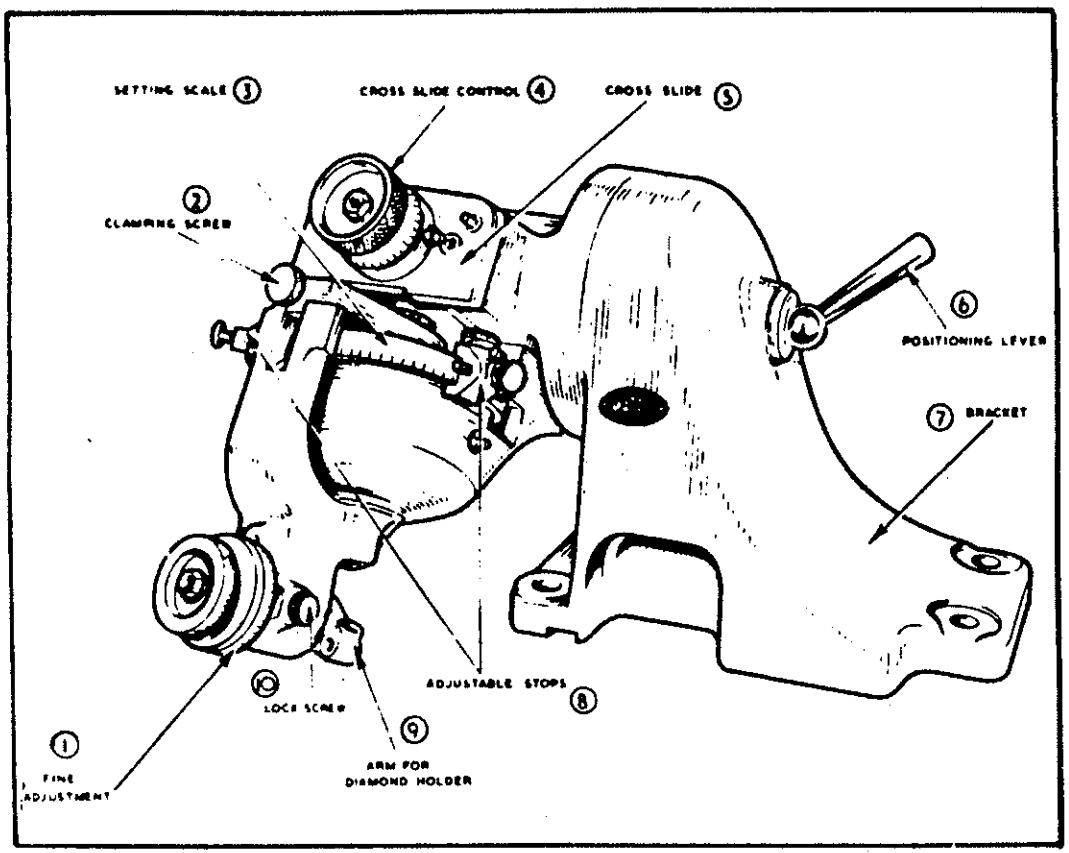


Fig. 1 VTA single point dresser

VTA SINGLE POINT DRESSER

INTRODUCTION

1. This dresser (Fig. 1) is used to form a single rib wheel for grinding small quantities, it is particularly useful when irregular thread forms are required. Where occasional Sharp Vee, Acme, Buttress and any other trapezoidal forms are encountered this dresser is a valuable asset.

GENERAL DESCRIPTION

2. The principle of the dresser employs two movements. First, a swivelling motion which enables a diamond to be presented to the wheel at any angle, and second a traversing motion which allows the diamond to be traversed across any tangent of the swivel arc. Fig. 2 shows the effects of these movements.

3. The dresser is mounted on a pivot which is housed in a bracket bolted to the top of the spindle housing. The pivot allows the dresser to be swung up clear of the wheel when not in use. A stop arrests the dresser in the working position and the positioning lever clamps it firmly to the bracket. Any further adjustments between the wheel and the dresser are made by rotation of a micrometer graduated feed knob which controls a cross-slide. The slide provides a bearing for the swivelling diamond bracket which allows the diamond to be presented to the wheel at any required angle. Adjustment of the moveable stops around the graduated circular scale determines the setting for various angles. A clamping screw in the swivelling diamond bracket holds it rigidly in any desired position.

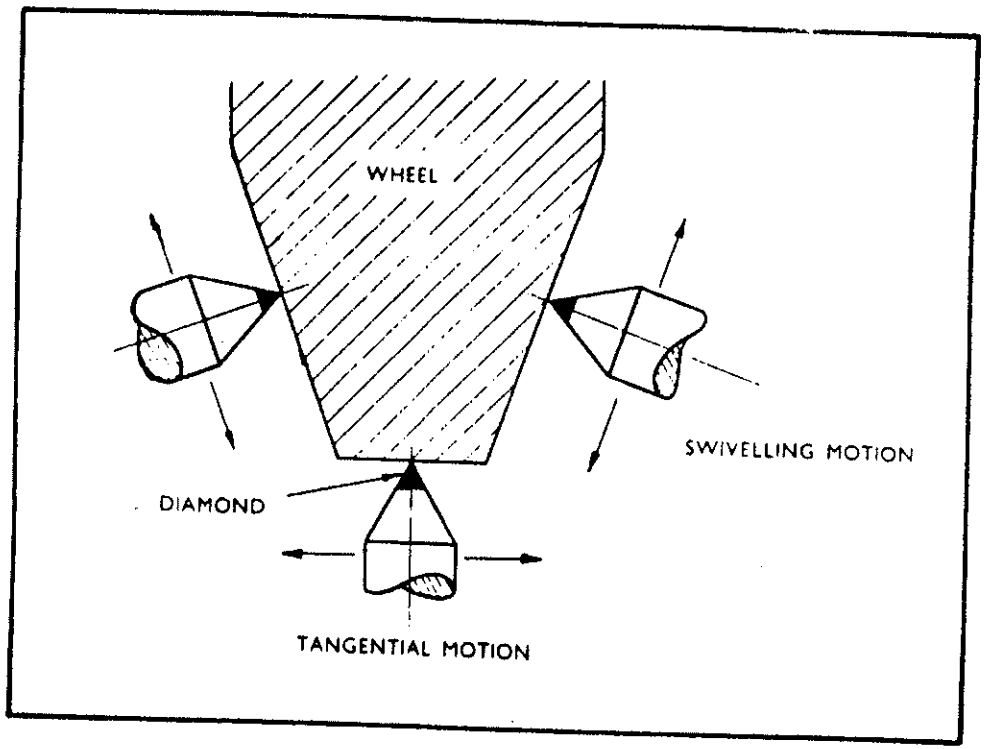


Fig. 2 Dresser action

4. At the base of the swivelling arm is a boss forming the housing for the diamond arm bearing. The knurled knob on the boss controls the traversing motion for dressing the flanks of the wheel. The larger micrometer graduated dial knob situated immediately behind the knurled knob controls the adjustment of the diamond relative to the central swivelling point of the bracket, and will therefore control the form produced on the crest of the wheel. A screw locks this control once the required form has been determined.

OPERATING AND SETTING INSTRUCTIONS

5. When using the single rib method of grinding, wheels of $\frac{3}{8}$ in. (9.5 mm) and $\frac{1}{4}$ in. (6.4 mm) width are satisfactory for most screw threads but a $\frac{1}{2}$ in. (12.7 mm) wheel can be dressed if required. Whichever wheel is used it must be correctly mounted on a suitable adaptor as shown in section 'G'. 'Vee' Form Wheels of the approximate required angle can be obtained from the manufacturer, but if a blank wheel is mounted, the form must be roughed out before using the Single-Rib Dresser. A rough hand diamond is satisfactory for this purpose, but before using this, the dresser, the machine slides, workhead and tailstock should be protected from the grinding wheel dust. Saturate the wheel with coolant periodically during the roughing out process to minimize dust. For both rough and finish dressing of the wheel the best peripheral speed is 2,000 feet per minute.

6. The dresser should be traversed along the pivot slide, by means of the feed knob, to ensure that the diamond will be well clear of the maximum sized wheel when the dresser is in a working position.

7. The sliding top wheel guard can now be removed and the dresser swung down and locked in the operating position. The two flank angles are set utilising the zero line on the swivel arm, and the positions secured by the adjustable angle control stops.

DRESSING 'SHARP VEE WHEELS'

8. Swivel the diamond bracket until it is located on one of the angle stops, then lock in position. Traverse the diamond across the face of the wheel and gradually feed the dresser in by means of the cross slide until contact with the wheel is made. Note the index figure and withdraw the dresser clear of the wheel by a definite number of revolutions of the feed control knob. Unlock the swivel arm, swivel the diamond bracket round until it engages the opposite angle stop, and lock it into position.

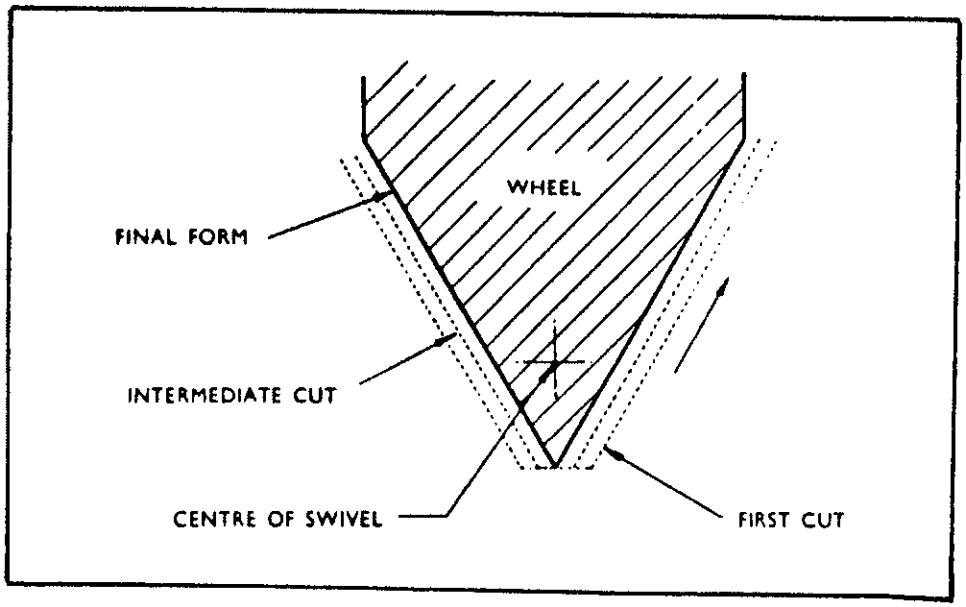


Fig. 3 Forming 'sharp vee' wheels

Repeat the previous operation until the diamond has again made contact with the wheel. The index figure should again be noted, and successive cuts not exceeding 0.002 in. (.0508 mm) should be taken until the diamond can be traversed down one flank of the wheel without any alteration to the feed control. The wheel flanks should now be central with the dresser. Traverse the diamond across both flanks of the wheel at a steady even motion with smaller cuts of 0.0003 in. (.007 mm) until a sharp point has been obtained as shown in Fig. 3.

DRESSING A 'RADIUSED CREST' WHEEL

9. First, dress the flanks of the wheel central with the dresser as described in para. 8, then gradually swivel the diamond bracket between stops and traverse the diamond across the wheel at several intermediate positions, as shown in Fig. 4.

10. A piece of thin feeler steel can be used for obtaining a template of the wheel form, and optical projection of this will determine the radius produced. The required radius is obtained by calculating the difference between the radius produced and the radius required, and making the necessary adjustments on the lower micrometer dial to alter the position of the diamond in relationship to its central swivelling point.

DRESSING FORMS REQUIRING FLAT CORES

11. Dress the flanks of the wheel central with the dresser, lock the dresser at zero and traverse the diamond across the wheel at that position. Take a template of the wheel, measure the width of the flat produced and compare it with the width desired. Make the necessary adjustments on the lower micrometer

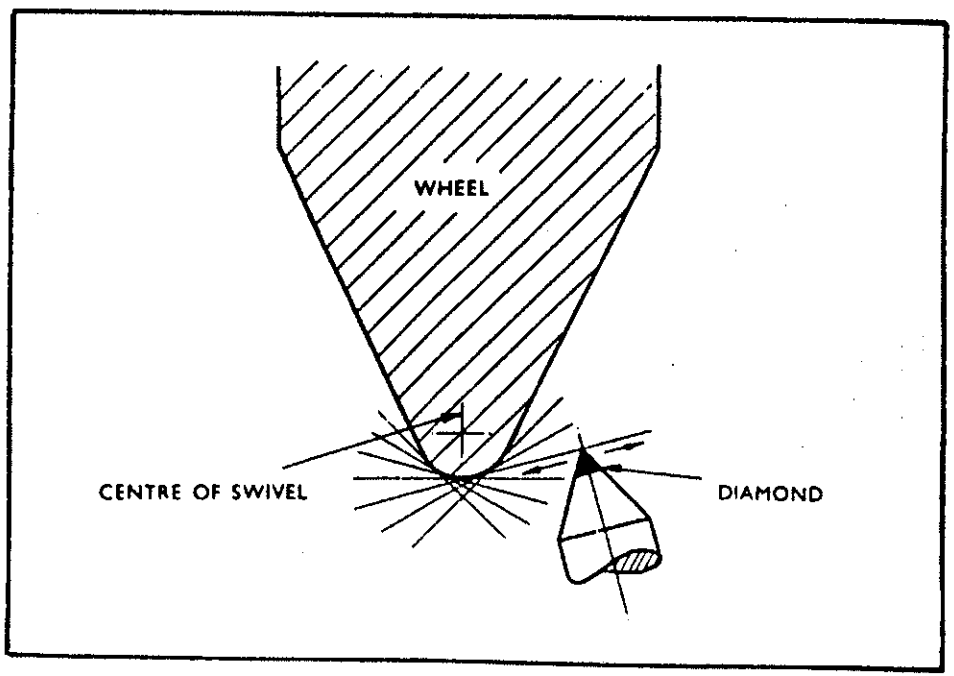


Fig. 4 Forming 'Radius Crest' wheels

dial until the required width is obtained; lock the lower micrometer dial in position. Any further adjustments of the dresser to the wheel should be made at the top feed. Re-dressings of the wheel are also controlled by this feed, and enables the operator to make the necessary adjustment to the machine infeed to correspond with the reduction on diameter of the wheel.

MAINTENANCE

12. Thoroughly charge all nipples with good quality lubricating oil daily.

13. If movement develops in the top pivot slide this can be eliminated by adjusting the gib strip screw which is located at the rear.

VTB/2 SINGLE POINT DRESSER (INTERNAL)

INTRODUCTION

14. The VTB/2 internal single point wheel dresser Fig. 5 is mounted to a common pivot unit secured to the wheelhead top attachment face, the pivot unit also being utilised in mounting the internal wheel multi-ribbed crusher unit. A stop arrests the unit in the operating position, it is then locked by the ball end lever Fig. 5 (2); releasing the lever permits the dresser to be swung clear of the wheel when not in use.

15. Dresser operation is similar to that of the VTA external single point unit described in paragraph 2. Adjustment between the dresser and the grinding wheel is effected through the barrel slide, operated by the graduated feed knob, Fig. 5 (3), the dresser body can be swivelled on the barrel flange to facilitate setting. Adjustable stops on the dresser body determine the flank angle setting in conjunction with a scale calibrated to 180 degrees, the swivelling centre section being secured in the operating position by a knurled thumbscrew.

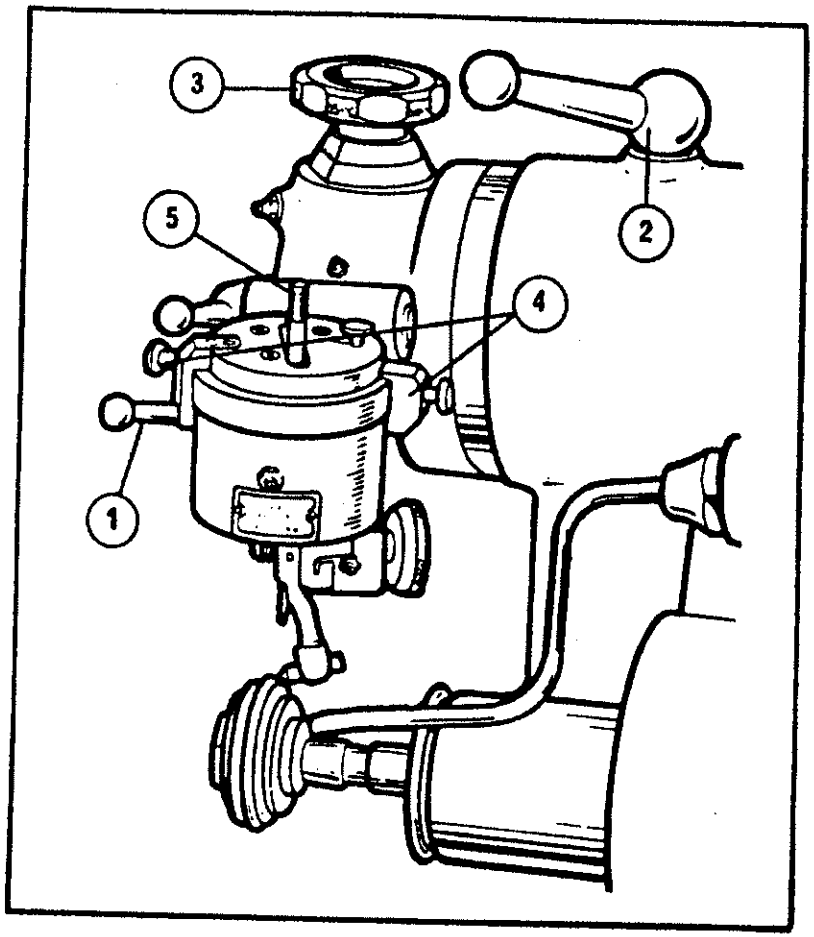


Fig. 5 VTB/2 single point wheel dresser

16. A boss at the base of the dresser swivelling centre section provides the mounting for the diamond arm, diamond adjustment relative to the swivelling centre section being controlled by the micrometer graduated knob at the rear of the boss to produce the desired wheel radius. A knurled lever projects from

the top face of the attachment and is secured by a flat spring to the diamond arm; operation of this lever effects the diamond traverse across the flanks of the wheel.

DRESSING 'SHARP VEE' WHEELS

17. Set the two adjustable stops Fig. 5 (4), release the centre section lockscrew and swivel the dresser to locate one of the preset stops; lock the centre section. Operate the knurled traverse lever (5) and traverse the diamond across the wheel flank, feeding the diamond into the wheel by operating the feed knob (3). Note the feed index figure; and re-set the diamond to dress the opposite flank by releasing the knurled securing screw and pivoting the centre section until it is arrested by the opposite stop. Repeat the previous operation until the diamond has again made contact with the wheel. The index figure should again be noted and successive cuts not exceeding .002 in. (.05 mm) taken until it is possible to traverse the diamond down the flank without adjusting the feed control. Repear this operation on the opposite flank; both flanks will now be parallel with the dresser. Traverse the diamond down both flanks with feed increments of .0003 in. (.0076 mm) until a 'sharp vee' is produced, see Fig. 3.

DRESSING 'RADIUS CREST' WHEELS

18. First dress the flanks of the wheel as described in paragraph 17. Once this condition has been achieved the diamond arm is positioned at points between the two stops and traversed across the point of the wheel (Fig. 4). Adjustment on the lower micrometer screw will effect the desired radius.

DRESSING FOR 'FLAT CORE' THREAD FORMS

19. Dress the flanks of the wheel as previously described, lock the dresser centre section at 90° and traverse the diamond across the wheel until the required width of flat is obtained by adjustment of the lower micrometer control. Once the desired form is obtained the lower control should be locked and any further adjustment made on the top feed knob.

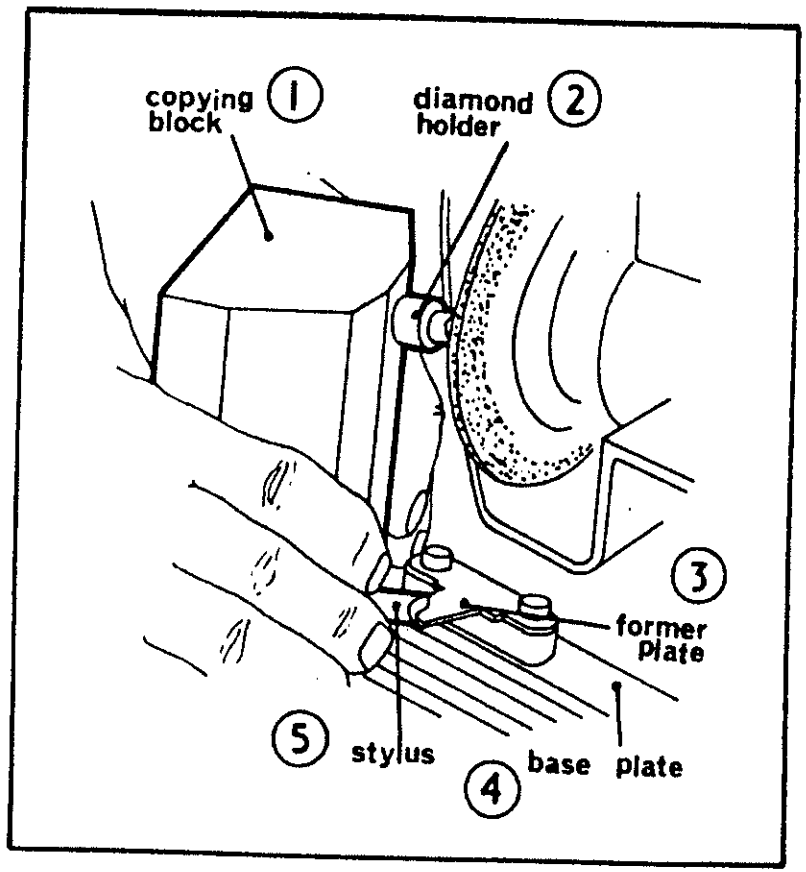


Fig. 6 11596 profile copying dresser

11596 PROFILE COPYING DRESSER

INTRODUCTION

20. The profile copying dresser Fig. 6 comprises a grooved base plate and hand operated copying block which houses the stylus and diamond holder, two tee bolts secure the unit base plate to the machine table. The former plate and the copying block manipulated on the base plate in such a manner that the stylus is made to follow the former plate profile thus imparting the desired form to the grinding wheel.

SETTING

21. For accurate results it is essential that the diamond and stylus should be set at exactly the same height in the copying block, also that they should closely approximate each other in form. The stylus should first be shaped allowing adequate clearance at the tip in order that the profile of the former plate will be followed accurately. Adjust the stylus slightly in advance of the diamond, set the copying block up on a surface grinding machine and grind the top of the stylus to the same height as the dressing diamond.

VTF. BALLFORM PROFILE DRESSER

INTRODUCTION

22. The V.T.F. single point profile dresser Fig. 7 is mounted to the machine on the basic V.T.B. base fitting, which also accepts the V.T.B./1 wheel crushing attachment and V.T.B./2 wheel dresser.

23. Dresser attachment is by two studs and securing hexagon nuts which pass through elongated slots on the V.T.B. attachment mounting face. The elongated mounting slots allow the dresser to be swivelled through 24 degrees.

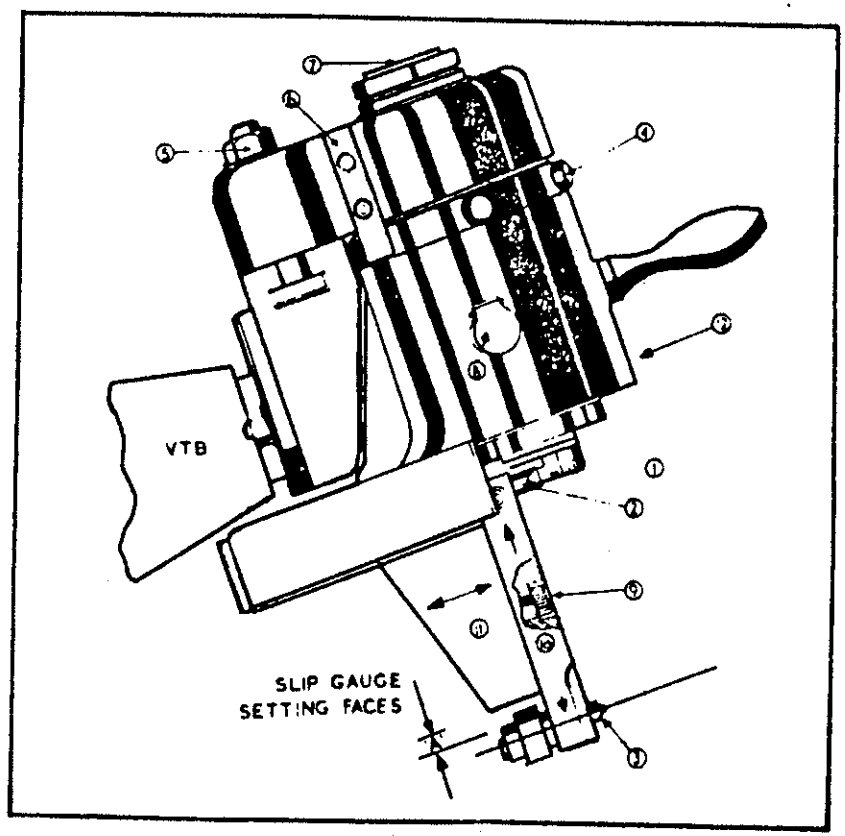


Fig. 7 V.T.F. Ballform profile dresser

24. The swivelling section of the dresser (12) is mounted in two precision ball races and pivots about the centre spindle through a maximum 155 degrees, arresting dowels (4) locating two stop plates (6) at the maximum swing. The former plate (1) which incorporates the required wheel form profile is secured to the centre spindle by a socket head screw. Former plates are supplied on receipt of details of the required form from the customer.

25. The stylus (2) and diamond holder (3) are secured to the front mounting plate, which is adjustable vertically on the rear slide (11) by releasing the retaining socket head screw. This adjustment facilitates correct diamond setting in relation to the angle of helix. Limited diamond adjustment in the form of a micrometer screw provides for minor radius corrections. Both the rear slide and front mounting plate assemblies are contained in 'Vee' section slides, supported by eight precision roller bearings. A spring mounted between dowels positioned in the dresser swivelling section and rear slide, ensures that the stylus is maintained in constant contact with the former plate.

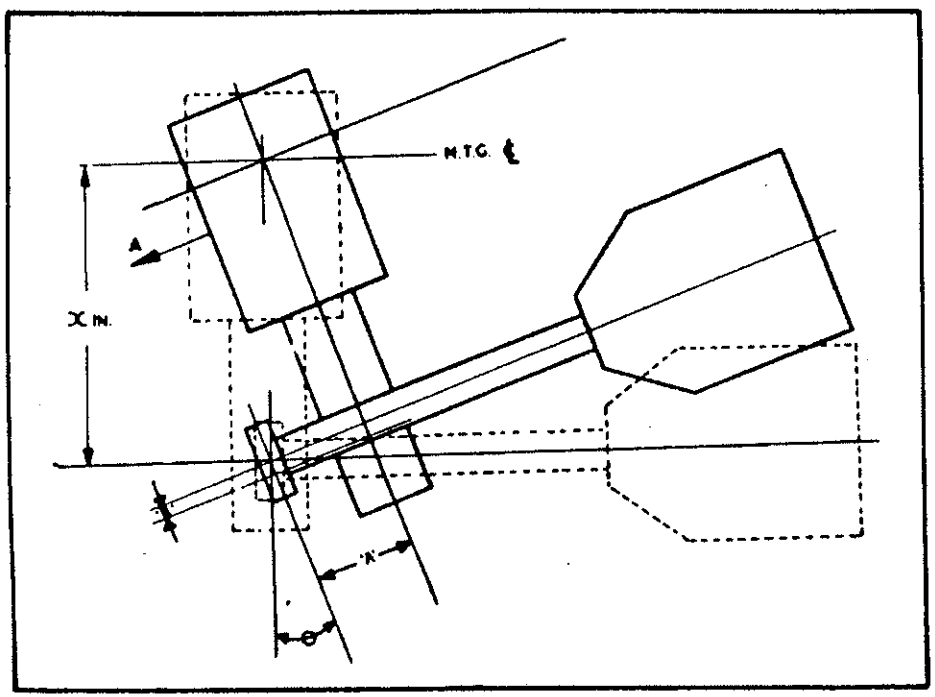


Fig. 8 setting calculations

26. Prior to setting the dresser, the stylus must be ground to impart the form of the dressing diamond. Remove the front mounting plate complete with stylus and diamond holder from the dresser, and set the diamond and stylus to ensure that both project on equal height from the front face of the mounting plate. Set up the assembly on a surface grinding machine and grind the stylus to produce a form at the tip identical to the form of the dressing diamond, thus ensuring that in operation the path of the wheel forming diamond will be identical to that of the stylus.

DRESSER SETTING

27. (1) Set the spindle head to the required helix angle.

(2) Set the dresser helix to position the dresser at 90 degrees to the spindle head (Fig. 8.)

(3) Release the tee bolt securing nut Fig. 7 (5) and position the dresser so that the diamond is correctly located on the vertical centre line of the grinding wheel (Position 'A' Fig. 8). Secure the tee bolt retaining nut.

Slip Gauge Setting				
Helix	Standard Spindle		High Speed Spindle	
Angle	in.	mm	in.	mm
0°	0.1500	3.8100	0.1500	3.5100
1°	0.1495	3.7970	0.1492	3.7910
2°	0.1479	3.7560	0.1470	3.7340
3°	0.1452	3.6890	0.1432	3.6390
4°	0.1416	3.5960	0.1380	3.5050
5°	0.1368	3.4750	0.1313	3.3340
6°	0.1310	3.3280	0.1230	3.1250
7°	0.1242	3.1540	0.1133	2.8780
8°	0.1163	2.9540	0.1021	2.5930
9°	-	-	0.0894	2.2710
10°	-	-	0.0752	1.9110

(4) The position of the diamond must now be adjusted as follows to effect a correct position on the horizontal centre line of the grinding wheel (Position 'B' Fig. 8).

(5) Release the front mounting plate retaining screw, and in accordance with the helix angle setting select slip gauges as detailed in the following chart.

(6) Adjust the front mounting plate, positioning the selected slip gauges between the two setting faces ('A' Fig. 7).

(7) Secure the front mounting plate retaining screw.

CALCULATING DRESSER SETTING (Fig. 8)

28. For helix angles other than those shown on the above chart, the slip gauge setting for diamond correction may be calculated from the formula X x Sin θ.
X equalling 3.465 in. (88.103 mm) with the standard wheel spindle and 4.922 in. (125.198 nn) with the high frequency spindle mounted.

MAINTENANCE

29. In general use the only maintenance required on the dresser is to ensure adequate periodic lubrication of the two ball races supporting the dresser swivelling section A lubrication nipple located under the spring cap (8) Fig. 7 being provided for this purpose. The recommended lubricant being Mobil Vactra No. 2 or other suitable equivalent.

27 VC. PROFILE COPYING DRESSER

30. The 27 VC profile dresser Fig. 9 is employed in wheel forming for operations such as hob or form grinding or other machine operations necessitating a narrow, profiled wheel. The unit comprises a frame casting incorporating a centre mounting bar at each end. A detachable driving carrier is fitted to engage

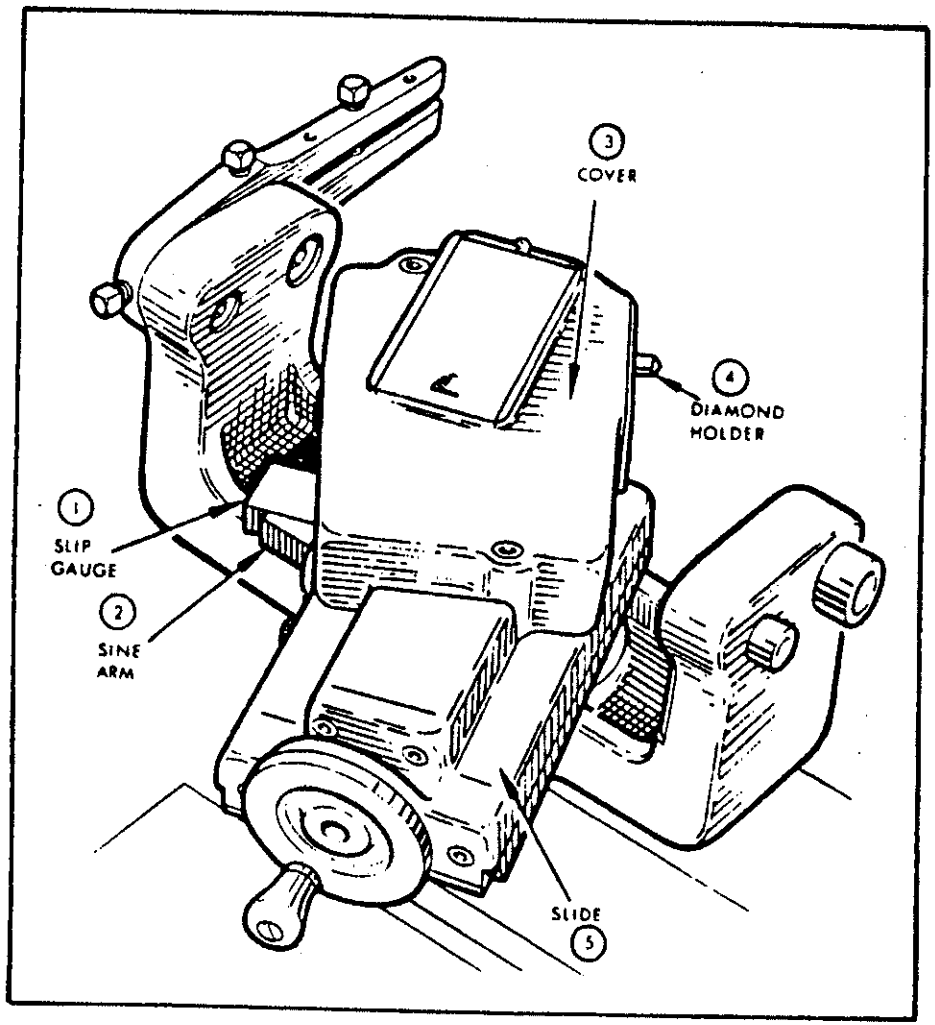


Fig. 9 27VC Profile dresser

the peg on the face plate and prevent rotation of the unit in use. The required wheel profile is imparted to a former plate secured to the dresser slide; the stylus and diamond carrier being free to follow the former plate profile, the desired form will be imparted to the wheel. The unit cross slide is adjusted by releasing the securing nut on the base of the unit; the required setting angle being achieved with slip gauges positioned between the sine arm and datum peg.

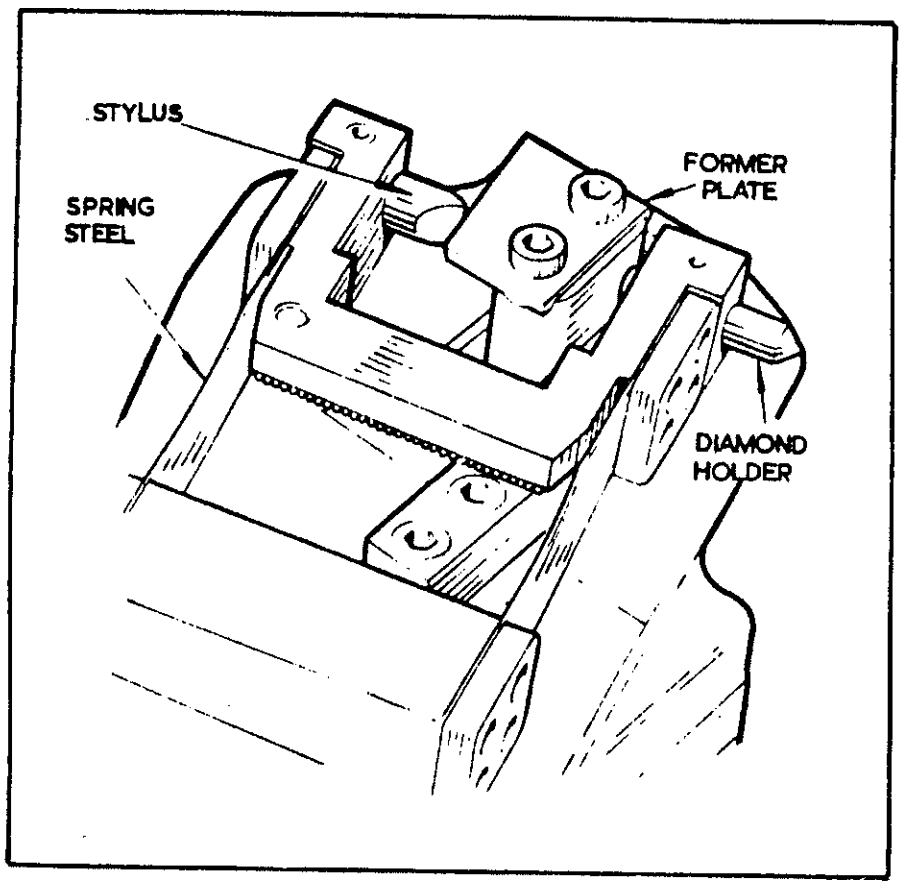


Fig. 10 27VC Dresser with top cover removed

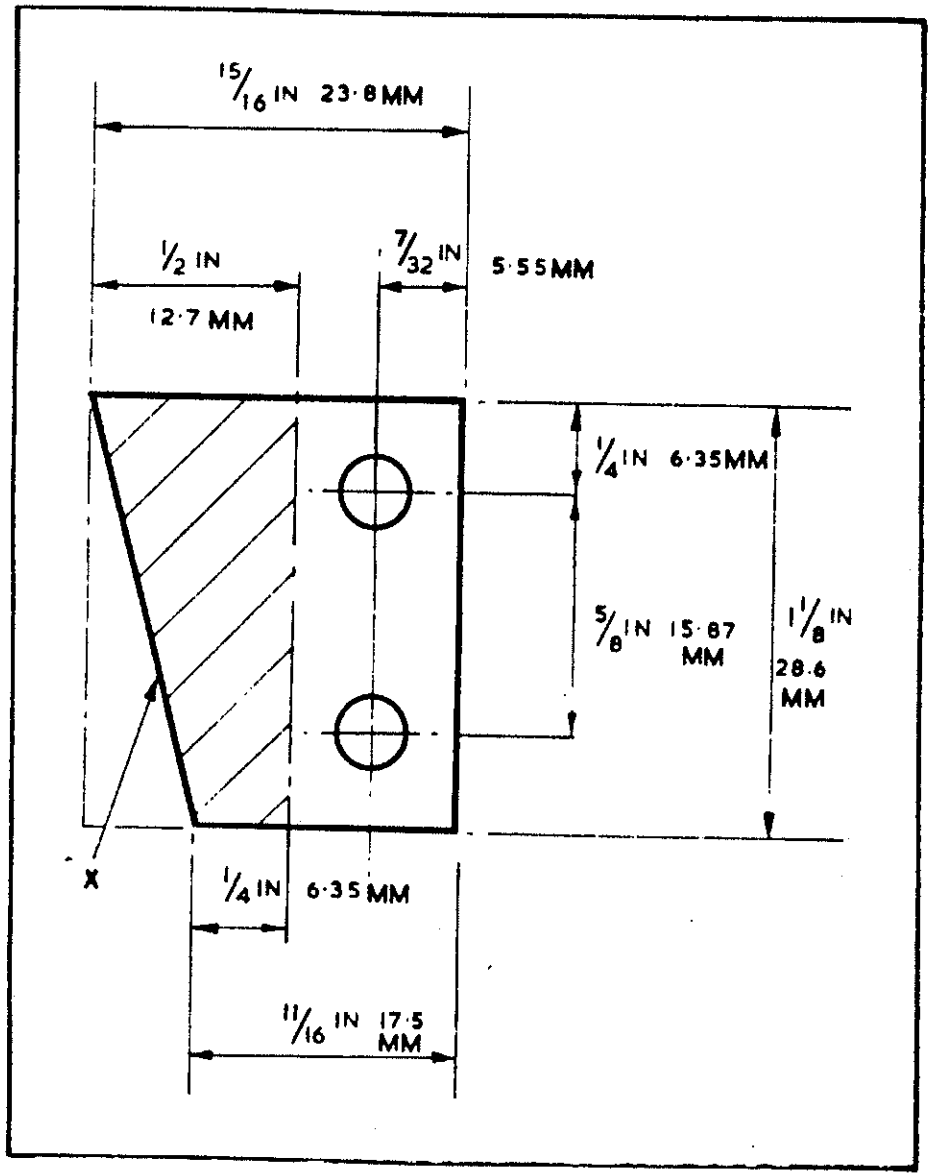


Fig. 11 Former plate dimensions

FORMER PLATES

31. These are produced from a standard blank of the dimensions shown in Fig. 11; the area of the blank which may be utilised in forming the profile is shown cross hatched. Diamond traverse is limited to 1.25 in. (38.5 mm); the maximum stroke being 0.5 in. (12.5 mm), care should be taken in forming the profile to ensure that it is parallel to line 'X'; thus reducing diamond action to a minimum.

OPERATION

32. Having profiled and mounted the former plate the dresser cross-slide should be set as previously stated; the dresser is mounted between the machine centres and carefully levelled to ensure that the wheel profile will be correctly imparted. Having formed one flank of the wheel the unit should be reversed between the centres to form the opposing flank. Feed increments should be approximately 0.001 in. (.025 mm) effected by the side cut control.

NOTE: It is important in producing the true form on the wheel that the tip of the stylus and the profiling diamond closely approximate in form.

11590 WORKCENTRE TRUING DRESSER

INTRODUCTION

33. The workcentre truer Fig. 12 is a valuable item of equipment facilitating the restoration of worn or mutilated centres to their original condition; the unit will impart to the grinding wheel the form necessary to accurately restore the 60° included angle to the centre.

34. The unit is mounted between the machine centres and supported in the operating position by a tee bolt secured to the machine

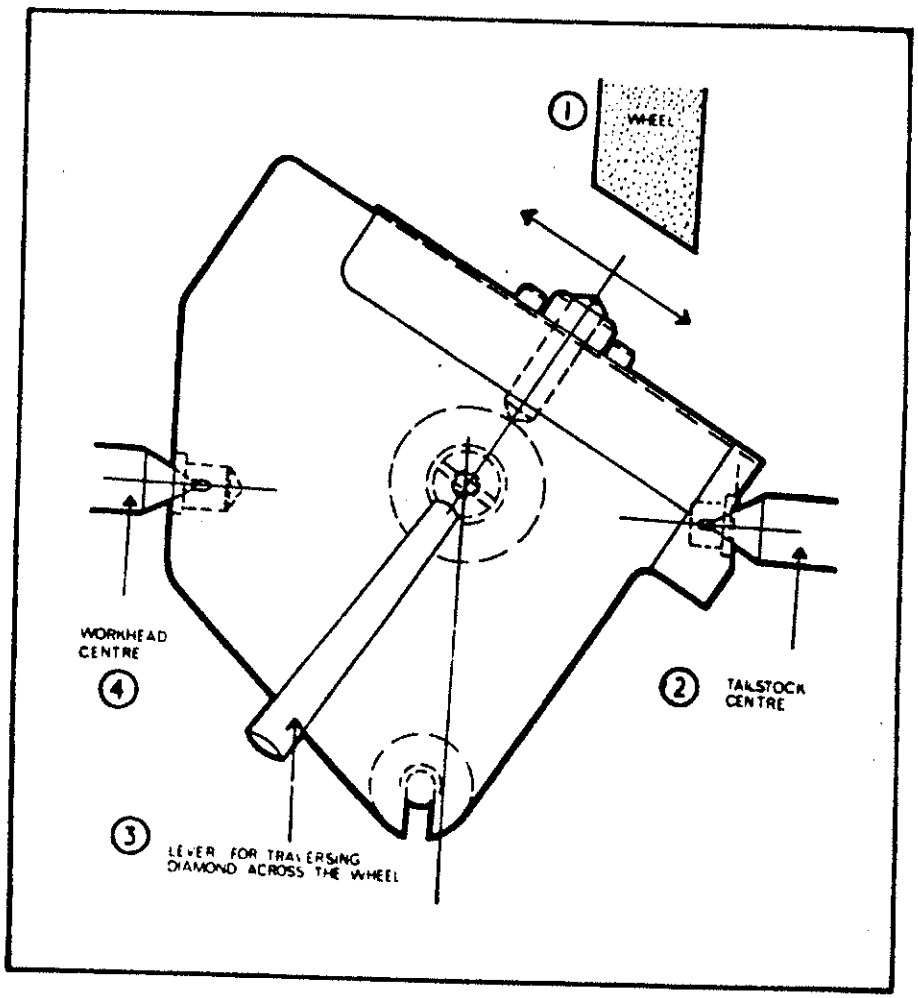


Fig. 12 11590 workcentre truer

table. A coiled tension spring is attached to the tee bolt and passes through a slot in the truer body to be secured by a knurled knob on the top face of the unit, maintaining the truer in contact with the support bolt. In addition the spring acts as a safety feature, allowing the truing diamond to be relieved should it be incorrectly presented to the wheel.

35. Mount a suitable diamond and holder in the truer slide, mount the unit between the machine centres and secure the support bolt. Traverse the table to suitably position the unit adjacent to the grinding wheel and effecting the necessary wheel infeed operate the diamond slide lever to impart the 30° angle to the wheel face.

MATRIX

V.T.G. Automatic Dresser

D

INTRODUCTION

The type V.T.G. Automatic Single Point Diamond Dresser is designed for speedy, accurate forming of sharp vee and trapezoidal thread forms. A system employing three diamonds is employed to form the grinding wheel to a maximum depth of ½ in. (12.7 mm).

PRINCIPLE OF OPERATIONS

1. A Single-phase, single-speed electric motor, mounted in the main dresser body, has a single start worm located on its armature shaft. This worm drives a 120 tooth wormwheel mounted on a shaft which also carries four cams and two trips.

2. The trips are arranged at 180° to each other and in relation to the four cams.

3. The function of the four cams is:-

   (1) The first cam bears on a springloaded push rod. This push rod contacts a rocker arm into which is fitted a diamond. 160° of rotation of the cam causes the push rod to sweep the diamond radially across the flank of the grinding wheel at the normal flank angle of the thread. Maximum depth of form ½ in. (12.7 mm).

   (2) The second cam moves a topping diamond in a horizontal path across the periphery of the grinding wheel. Down-feed to this diamond is imparted by rotating a graduated knob on the front of the dresser(see figure 2). Rotation of this knob imparts lineal movement to a push rod by turning a feedscrew which is attached to the end of the push rod. The other end of this rod has a 45° angular face which bears on an opposing, similar face on a spring-loaded, vertical topping diamond arm to transit movement to the diamond.

   (3) The third cam performs in a similar manner to the first cam on another diamond which forms the other flank of the grinding wheel. When the diamond is at the top of its stroke, the third is at the bottom and vice versa.

   (4) The fourth cam has two segmental lobes and each lobe imparts a 20° rise and 10° fall to a rocker arm. The 20° od rise occurs whilst the diamonds are stationary during which time the rocker arm is raised. A pawl attached to the rocker arm engages either one or two teeth of a ratchet wheel attached to a feedscrew. This feedscrew controls vertical movement of the main dresser body which slides in dovetail ways on the column.

   The electrical equipment is installed within the column.

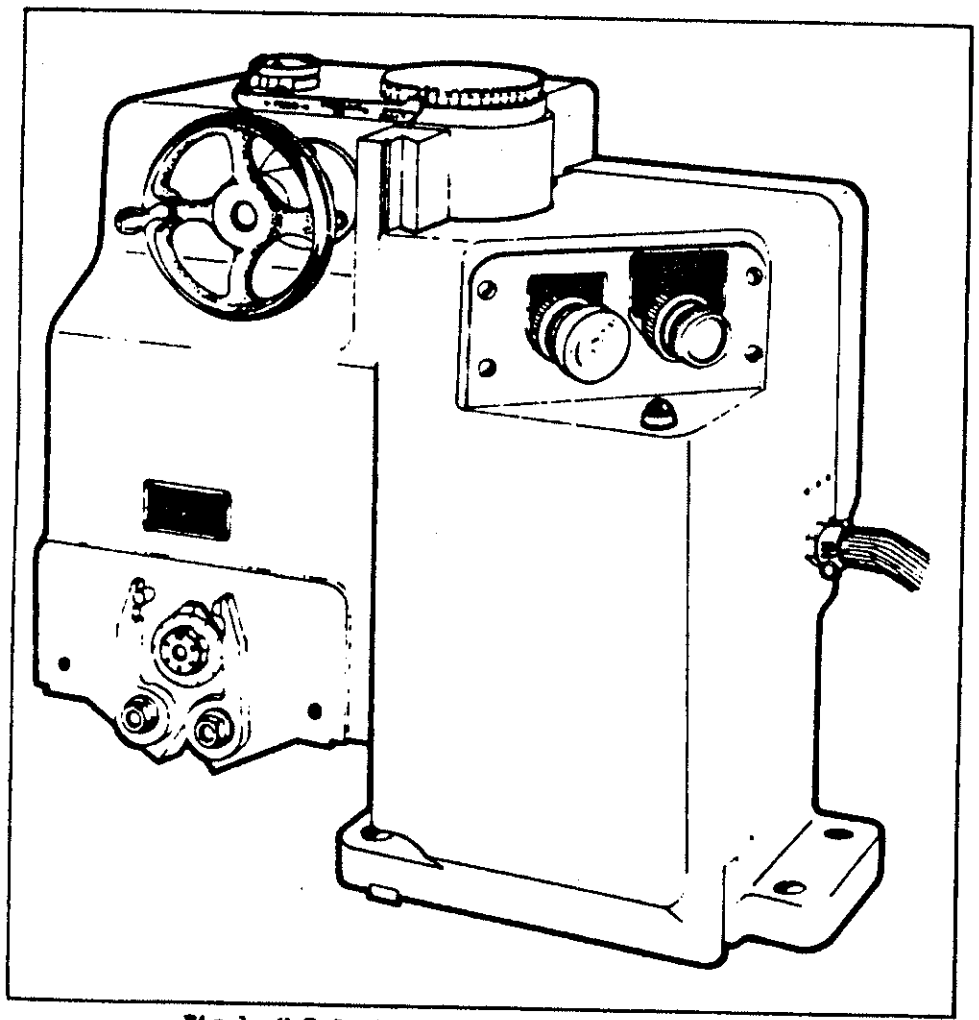


Fig.1 V.T.G. AUTOMATIC DRESSER

VERTICAL FEED HANDWHEEL

4. This handwheel, on the front of the dresser body, controls the vertical movements of the dresser body. A graduated circular scale fitted on the top of the dresser indicates the increments of feed. (0.0005in or 0.01 mm per division according to whether English or Metric scales are fitted).

AUTOMATIC DOWNFEED INCREMENT SETTING

5. Incremental downfeed is set on the scale immediately to the left of the vertical feed handwheel scale and enables the selection of the amount of downfeed per pass of the diamonds.

TOPPING DIAMOND FEED CONTROL

6. This knob is between the flank angle control arms (see figure 2). It controls the vertical feed to the topping diamond. Clockwise rotation of the knob increases the downfeed and counter clockwise rotation decreases it. The graduations on the dial indicate 0.001in. or 0.02 mm division.

SETTING OF FLANK ANGLE CONTROL ARMS

7. The position of the flank angle control arms must be set accurately to obtain a correct form on the grinding wheel.

8. Setting is as follows:-

(1) Slacken the nuts holding the arms (see figure 2). The arms will now swivel.

IMPORTANT: The nuts should not be removed because the left-hand nut has a right-hand thread, and the right-hand nut has a left-hand thread.

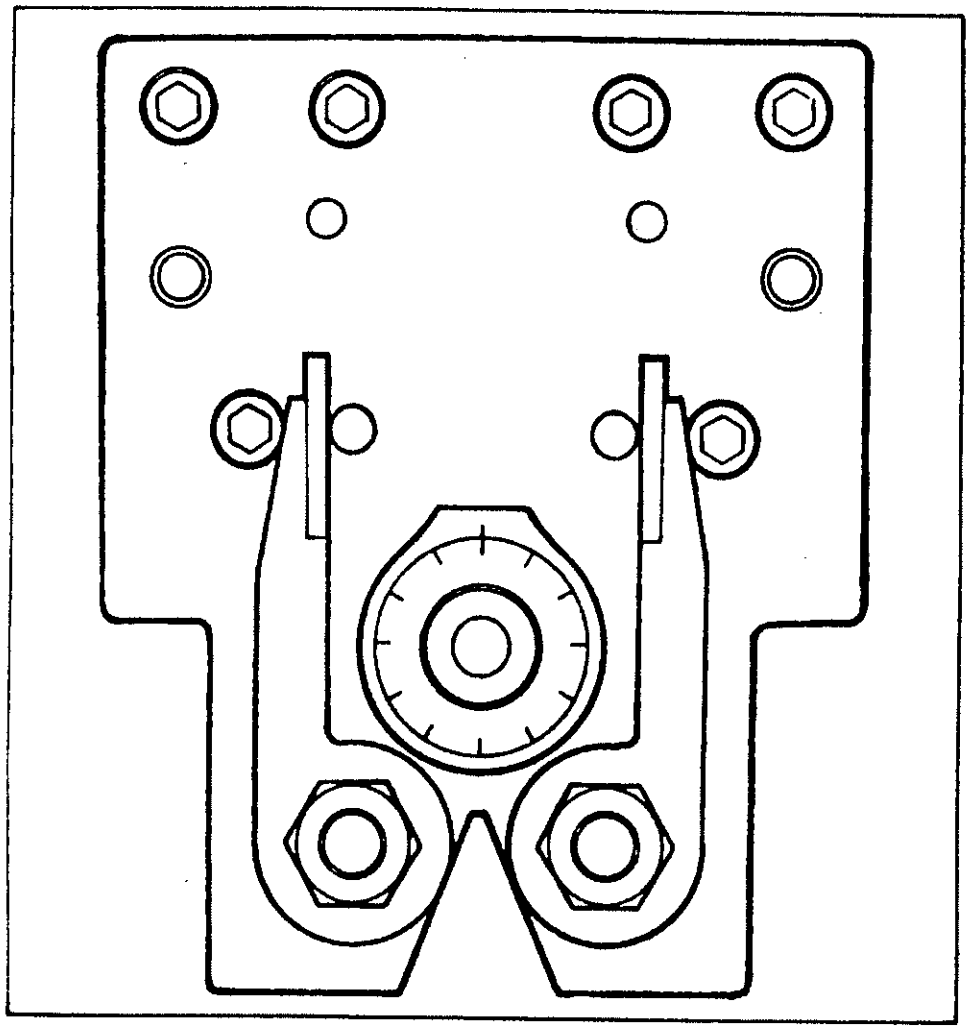


Fig.2 Flank Angle Control Arms

(2) Fit slip gauges (gauge blocks) between the arms and the stop pegs. The formula for calculating the correct slip gauges:-

2.5 x Sine (30° - ½ Thread Angle) + 0.125in.

(3) With the slip gauges in position, re-tighten the nuts.

(4) Remove the slip gauges.

SETTING THE FLANK DIAMOND.

9. Clean the face on the diamond arm from which the diamond protrudes. Place the setting gauge against a face of the diamond arm. Slacken the socket grub screw holding the flank angle diamond. Slide the diamond until it contacts the stepped face of the gauge. Tighten the socket grub screw (see figure 3). Repeat the process on both diamonds.

NOTES ON THE SETTING GAUGE

10. This gauge has a set of steps ground on its ends. These steps have been calculated to set the diamond for dressing the following thread forms.

0.2801in.	(7.11mm) step is used for all	60°	S.V. threads
0.1901in.	(4.60mm) step is used for (a)	29°	- 4-16 T.P.I.
	(b)	30°	- 0- 8 mm pitch
0.1501in.	(3.72mm) step is used for (a)	29°	- 2½-6 T.P.I.
	(b)	30°	- 8-11 mm pitch
0.1101in.	(2.79mm) step is used for (a)	29°	- 2 T.P.I.
	(b)	30°	- 11-14 mm pitch

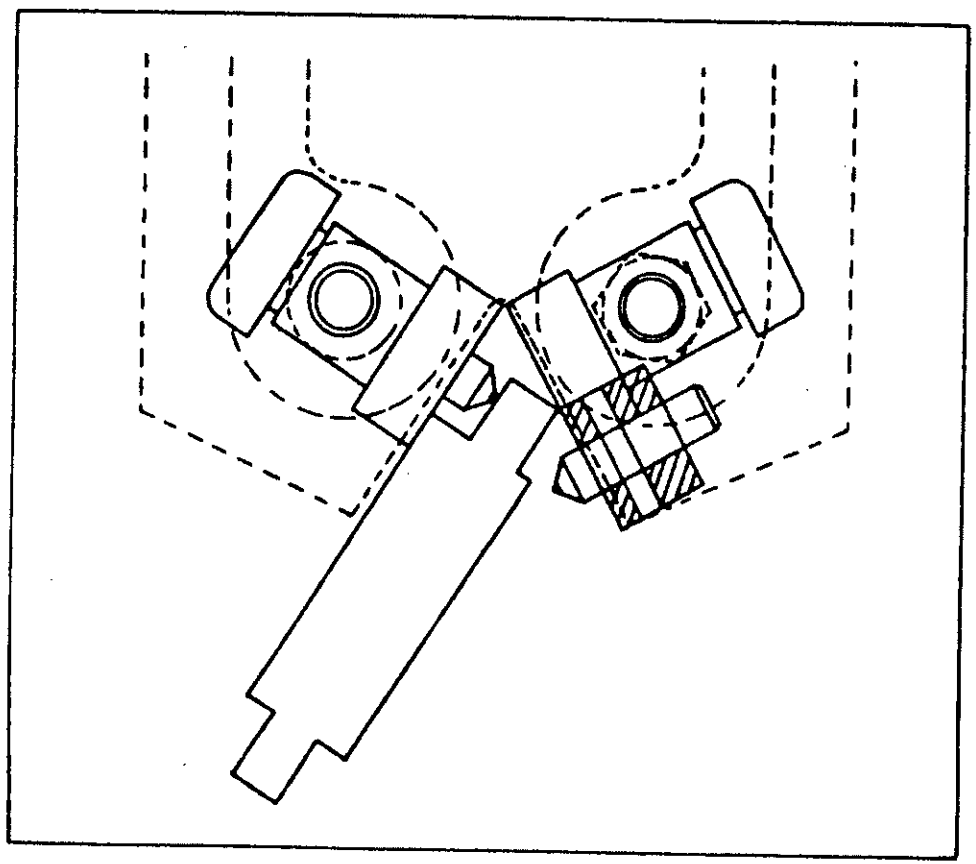


Fig.3 Setting the Flank Angle Diamonds

ELECTRICAL CONTROLS

11. The dresser is electrically connected to the machine by a multiple pin plug and socket at the rear of the wheelhead.

12. A small electrical panel is fitted to the front of the unit.

    (1) The top button has two functions:-

        (a) The outer sleeve can be rotated for cycle selection. The rotating sleeve has two positions - CONTINUOUS and SINGLE.
        To select CONTINUOUS, rotate the sleeve clockwise.
        To select SINGLE, rotate the sleeve counterclockwise.

        (b) The actual button itself is depressed to start the cycle.

    (2) The lower button must only be depressed to stop the dresser in an emergency, because it will stop the dresser in mid-cycle.

    A limit switch is fitted to the vertical slide to prevent excessive downfeed.

SETTING AND OPERATING INSTRUCTIONS

MOUNTING THE DRESSER

13. Remove the four nuts and washers from the studs on the top of the grinding spindle.

14. Clean the joint face of the grinding wheel and the base face of the unit. Ensure that no burrs are present on either face. If burrs exist, remove them by stoning lightly.

15. Locate the studs on the top of the spindle in the holes in the base of the dresser. Replace and tighten the nuts and washers.

16. Connect the electrical supply.

17. Adjust the thread angle control arms.

18. Turn the vertical feed handwheel and raise the main dresser body to render the diamond accessible.

19. Set the flank angle diamonds.

20. Set the topping diamond.

21. Set the downfeed increment lever.

22. Manually feed the dresser body downwards until one of the flanking diamonds almost contacts the wheel.

23. Select the cycle required.

24. Press the "CYCLE START" button.

25. If 'CONTINUOUS' has been selected, rotate the cycle selector switch to 'SINGLE' to stop the dressing cycle.

11246 GENERATING DRESSER

INTRODUCTION

1. The reciprocating 'straight line' cutting action of the dresser diamond moving through a helical path is used to 'profile' grinding wheels for production of the following types of ruled helicoids: -

   (a) Acme and Buttress threads.

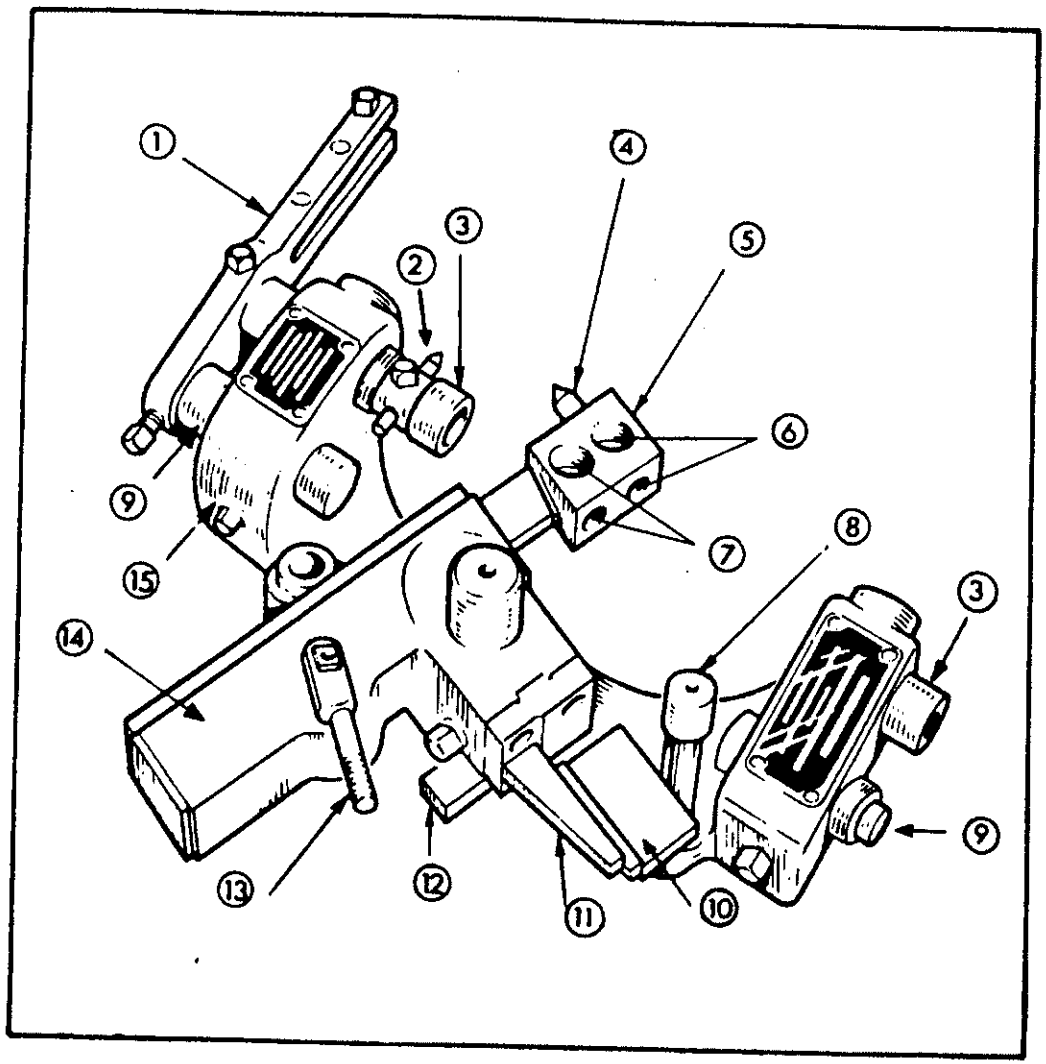
   (b) Worm threads with a straight line flank in the axial plane.

   (c) Involute helicoid worms.

   (d) Worm threads with a straight line flank in section normal to the helix.

2. The dresser can also be used to profile wheels for grinding worm form crushing rollers.

3. After dressing a grinding wheel, a profile template can be ground to facilitate accurate production of the required form of a thread-



(1) Driving Carrier

(2) Topping Diamond

(3) Centre Bars (in 'front' location holes)

(4) Dressing Diamond and Holder

(5) Transverse Slide Head

(6) 'Front' Location Holes for Diamond Holder

(7) 'Back' Location Holes for Diamond Holder

(8) Datum Peg in right hand location holes.

(9) Driving Studs (in 'back' centre location holes)

(10) Angle-setting Slip Gauges

(11) Sine Bar

(12) Off-set (height) Slip Gauge

(13) Slide Actuating Lever

(14) Swivel Block

(15) Frame Casting

Fig. 1 11246 Generating Dresser

milling cutter. (Note: It is imperative that the wheel and cutter are the same size.)

4. Certain helicoids such as square threads are geometrically impossible to produce using a disc type milling cutter or grinding wheel and the relative profile cannot be formed using a generating dresser.

GENERAL DESCRIPTION (Refer to Fig. 1)

5. The body of the dresser is a frame casting with a laterally adjustable 'recessed-centre' mounting bar at each end; the mounting bars may be fitted in either of two sets of parallel holes, depending on the 'form' requirements.

6. The longer of the two centre bars can be fitted with a diamond for topping (truing) the periphery of the grinding wheel.

7. The driving carrier is mounted on one of the centre bars, and clamped on the eccentric spigot of the driving stud fitted in the adjacent centre bar locating hole.

8. The swivel block pivots on a pillar in the centre of the frame casting. On either side of the pillar, at an exact centre distance of 2.5 inches (63.5 mm), two tapered bushed holes locate the datum peg. Slip gauges (calculated value 'C') inserted between a sine arm on the swivel block and the datum peg, enable precise setting of the diamond slide traverse angle of operation. For certain threads, slip gauges (calculated value 'V') are fitted beneath the swivel block to give the precise off-set (height) of the diamond coincidental with the straight line generator of the form to be produced.

9. The slide locates in an adjustable sleeved groove in the swivel block and works on the rack and pinion principle. The pinion spindle has protruding square ends to facilitate fitment of the actuating lever.

10. The slide head has two parallel horizontal bores for location of the diamond holder when profiling grinding wheels for general threaded work and two vertical parallel bores for location of the diamond holder when dressing bevelled grinding wheels used for hob and milling cutter sharpening.

11. A 'roughing' diamond and holder, for initial dressing of the grindwheel, and a finishing diamond and holder are supplied with each dresser unit.

CALCULATIONS

12. The formulae to determine the value 'C' of the angle-setting slip gauges, value 'V' of the off-set slip gauges and value 'W' equal to the width of the wheel (finished size) for the different types of thread are as follows: -

13. <u>Acme or Worm Threads with Straight Flanks in the Axial Section</u>

For these types of threads there is no 'off-set' of the swivel block.

θ = Axial flank angle (= ½ included angle of the thread in the axial section)

C = 2½ inches (63.5 mm) x Sin θ

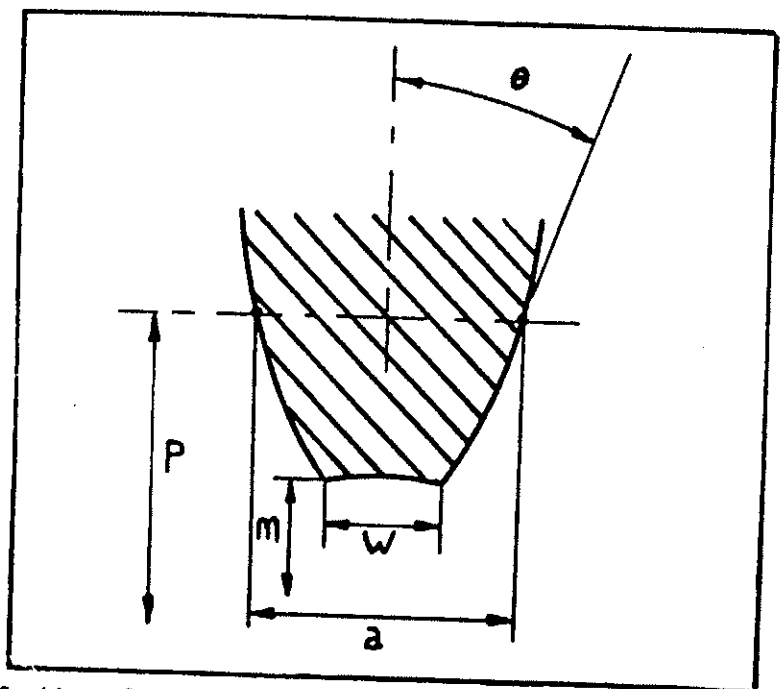
A guide to wheel width can be obtained from the following formulae:

Where a = width of space at 'P'
P = Pitch circle diameter
m = Minor diameter

W = Width of wheel at tip
= a(P-m) Tan θ Cos. lead angle

With this type of thread make the wheel width slightly less than the value 'W' and finally 'side-cut' the thread to the required finished size.

NOTE: The value 'W' is the theoretical width of a space in a corresponding rack and is greater than the actual width of wheel required at minor diameter 'm'.



Section of grinding wheel in Plane Containing Axis of Wheel.

14. Involute Helicoid Worms

Where A = Lead angle at 'P'
Bl = Normal pressure angle at 'P'
θ = Angle of the straight line generator
H = Intermediate Angle
P = Pitch circle diameter

Calculate slip gauge values 'V' and 'C' from the following:

$\text{Tan } H = \text{Tan } B_1 . \text{ Cosec } A$

$V = \frac{P}{2} \times \text{Cos. } H$ (= Base circle radius)

$\text{Tan } \theta = \frac{\text{Lead}}{2\pi V}$

C = 2½ inches (63.5 mm) x Sin θ

For threads with a small lead angle the following formula is recommended: -

$\text{Cos } \theta = \text{Cos } A . \text{ Cos } B_1 .$

$V = \frac{\text{Lead}}{2\pi \text{ Tan } \theta}$

The following formula gives the theoretical width at a certain point on the generated form of a wheel which will finish grind both flanks of the involute helicoid simultaneously. If it is desired to finish to size by 'side-cutting' on one flank, the wheel width must be reduced accordingly.

Where A = Lead angle at 'P' diameter. $\text{Tan } A = \frac{L}{P}$

B_1 = Normal pressure angle at 'P'

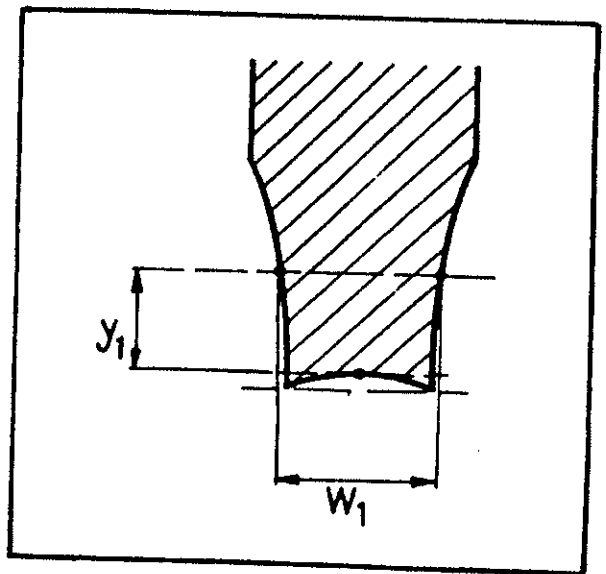
'P' = Pitch circle diameter at which the normal pressure angle = B_1.

L = Lead

m = Required minor diameter of the work.

Note: Pitch diameter 'P' is that which can be calculated from the 'number of teeth (or starts)', the 'lead angle A', the 'module', 'diametral pitch' or 'circular pitch'.

Case 1



Section of Grinding Wheel in Plane containing Axis of Wheel.

Case 1

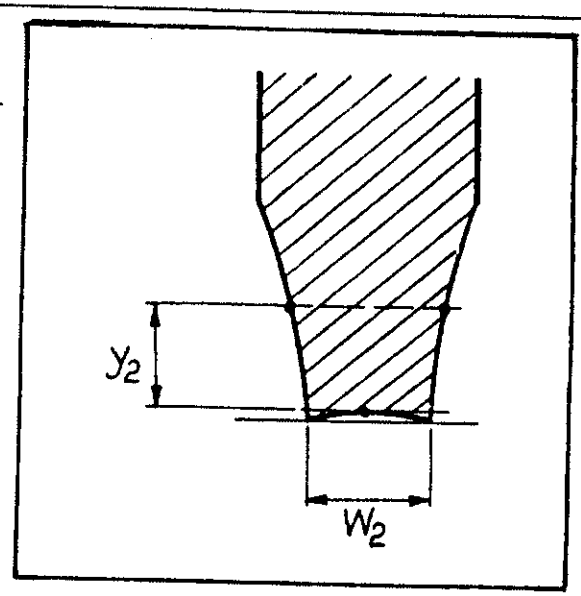
When axial space 't' at 'P' diameter is given and the grinding wheel, both when dressing and grinding, is inclined at angle 'A' to the work axis; then dimensions W_1, and y_1, are derived from the following formulae: -

$$W_1 = t.\text{Cos } A.\ \text{Cos}^2 B_1.$$

$$y_1 = \tfrac{1}{2}\ (P - m - t.\text{Cos } A.\ \text{Cos } B_1.\ \text{Sin } B_1.)$$

Note: - The included angle between the lines drawn tangent to the wheel form at the points so found = $2B_1$.

Case 2



Section of Grinding Wheel in Plane Containing Axis of Wheel.

Case 2

When axial space 'S' is given at a diameter 'D' (not the pitch circle diameter); the grinding wheel both when dressing and grinding is inclined at an angle A_1 = lead angle at 'D' ($\text{Tan } A_1 = \frac{L}{\pi D}$) the dimensions W_2 and y_2 are derived from the following formulae:

Where $\text{Cos } \phi = \frac{(\text{Cos } A.\ \text{Cos } B_1)}{(\text{Cos } A_1)}$ = Normal pressure angle at diameter 'D'

Then $W_2 = S.\ \text{Cos } A_1.\ \text{Cos}^2 \phi.$

$$y_2 = \tfrac{1}{2}\ (D - m - S.\ x\ \text{Cos } A_1.\ \text{Cos } \phi.\ \text{Sin } \phi).$$

NOTE: The included angle between lines drawn tangent to the wheelform at the points so found = 2ϕ.

and 'C' from the following:

Where P = Pitch circle diameter

A = Lead angle of thread at 'P'

B_2 = Normal pressure angle (= ½ included angles of the theoretical tool at 'P')

D = Intermediary angle.

E = Minor Apex radius = $\frac{P}{2}$ - (½ width of the theoretical tool (along a line tangent to 'P') x Cot B_2).

θ = Angle of the straight line generator.

Tan D = Tan B_2. Sin A.

V = E. x Sin D.

Tan θ = Cot A Sin D.

C = 2½ inches (63.5 mm) x Sin θ.

For threads with a small lead angle the following formulae is recommended:

Sin θ = Cos A Sin B_2.

V = E x Tan A. Tan θ.

The width W_4 of the grinding wheel is calculated from the following:

Where a = Width of theoretical tool along a line tangent to 'P'

m = Minor diameter to be ground

P = Pitch circle diameter

A = Lead angle at 'P'

If the wheel is inclined at the lead angle (A)

Then W_4 = a. $Cos^2 B_2$

$y_4 = \frac{P}{2} - \frac{1}{2} m - \frac{1}{2} a \text{ Cos } B_2 . \text{ Sin } B_2$.

Note 1: The above formulae is only applicable to the type of thread as would be produced by a male lathe tool set normal to the helix. Dimension 'W_4' is the theoretical width at a certain point 'y_4' on the generated form of wheel which will finish grind both flanks of the thread form required.

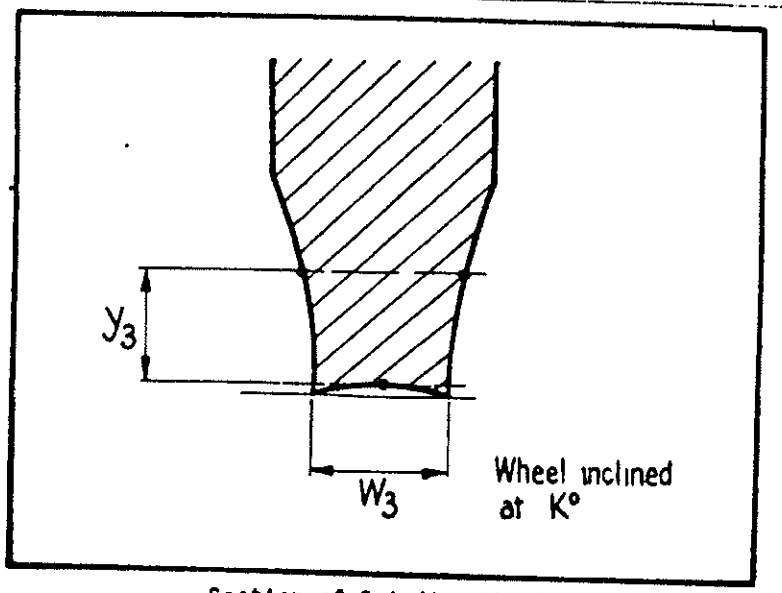
Note 2: It is advisable with this type of thread, to make the width of the wheel slightly less than the value 'W_4' and finally grind the thread space to required finished size by 'side-cutting'.

(b) For forms as would be produced with an enveloping tool (or chaser) set normal to the helix (Fig. 2B), calculate the slip gauge values 'V' and 'C' by substituting 'F' for 'E' in formulae 15 (a) above.

Where F = Major apex radius = $\frac{P}{2}$ + (½ width of theoretical tool (along a line tangent to 'P') x Cot B_2).

(c) For forms as would be produced with half-tools set normal to the helix, mid-points 'P' in the same axial plane (Fig. 2C), calculate slip gauge values 'V' and 'C' substituting '$\frac{P}{2}$' for 'E' in formulae 15 (a) above.

Case 3



Section of Grinding Wheel in Plane Containing Axis of Wheel.

Case 3

When axial space 'S' is given at diameter D (as in case 2) but the grinding wheel is not inclined at A, but at some other angle 'K' during grinding and dressing, then dimensions W_3 and y_3 are derived from the following formulae:

Where $Z = \frac{L}{\pi \text{ Tan } K}$

$$\text{Cos } \phi_1 = \frac{(\text{Cos A. Cos B}_1)}{(\text{Cos K})}$$

$$g = Z. \times \text{Sin K.} \left(\frac{\pi S}{L} - \text{Invr.} \frac{D}{2V} + \text{Invr.} \frac{Z}{2V} \right)$$

Then $W_3 = g. \text{ Cos}^2 \phi_1.$

$$y_3 = \tfrac{1}{2} (Z - m - g. \times \text{Cos } \phi_1. \text{ Sin } \phi_1.)$$

Note 1: Invr. $\frac{D}{2V}$ = (Tan h - h radians) where

Sec. h = $\frac{D}{2V}$

Invr. $\frac{Z}{2V}$ is found similarly

Note 2: If K = A, then g = P. and $\phi_1 = B_1$

Note 3: The inclined angle between lines drawn tangent to the wheelform at the points so found = $2 \phi_1$.

The section diagrams show the tip of the grinding wheel with an exaggerated concave form; this is the theoretical profile required to produce a cylindrical minor diameter but normally the actual amount of concavity is negligible.

In certain extreme cases, when the tip width of the wheel is large, the lead angle to which the wheel is set is large, and the minor diameter of the work is small, it is possible that the concavity might have to be considered when setting the wheel to grind the core radius (refer to setting and operating instructions).

15. Worm Threads with Straight Flanks in section Normal to the Helix.

'Figure 2' illustrates the different methods of producing these types of worm threads using three theoretical types of lathe tools set normal to the helix. The same principles are utilised in the formulae for producing the appropriate grinding wheel profiles, as follows:

(a) For forms as would be produced with a male tool set normal to the helix (Fig. 2A), calculate the slip gauge values 'V'

In the following three instances the straight-flank section is inclined to the axial section at an angle equal to the lead angle of the thread. The intersection of these two sections forms an imaginary datum line 'R'. The three types of normal section differ in respect of the point at which the radial line intersects the thread flank.

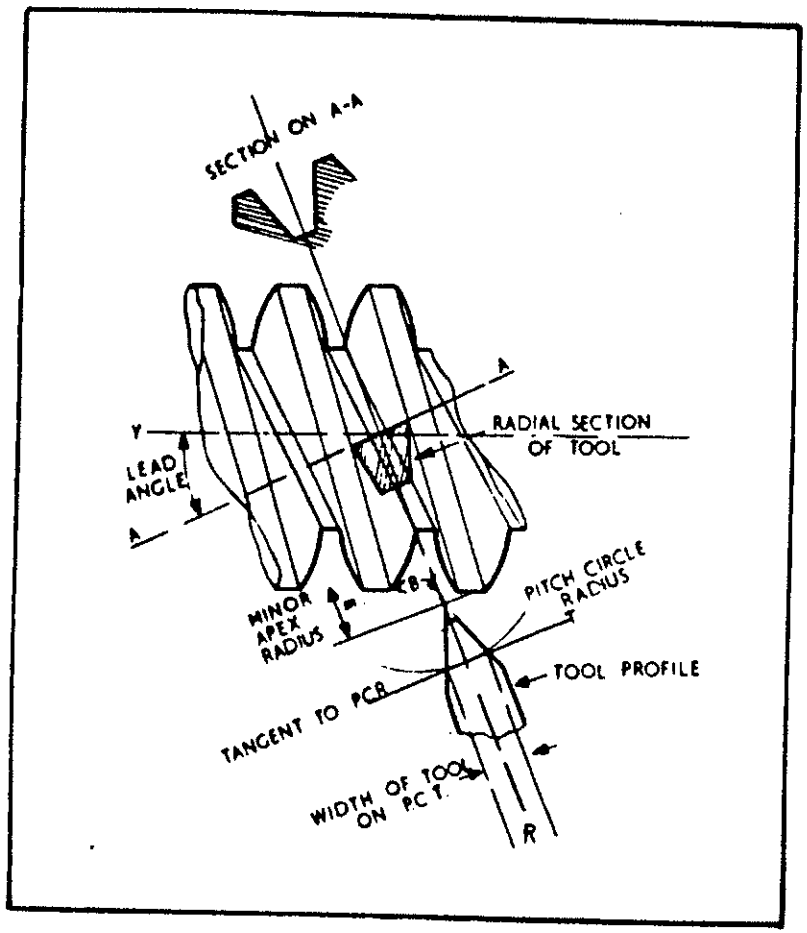


Fig. 2A Lathe worms produced by male tool set normal to the helix.

Fig. 2A

In the case of a thread as would be produced by a male tool inclined at the lead angle, the radial line coincides with the centre line of the thread space and intersects the sharp vee which would be formed at the minor diameter if the thread flanks were not truncated.

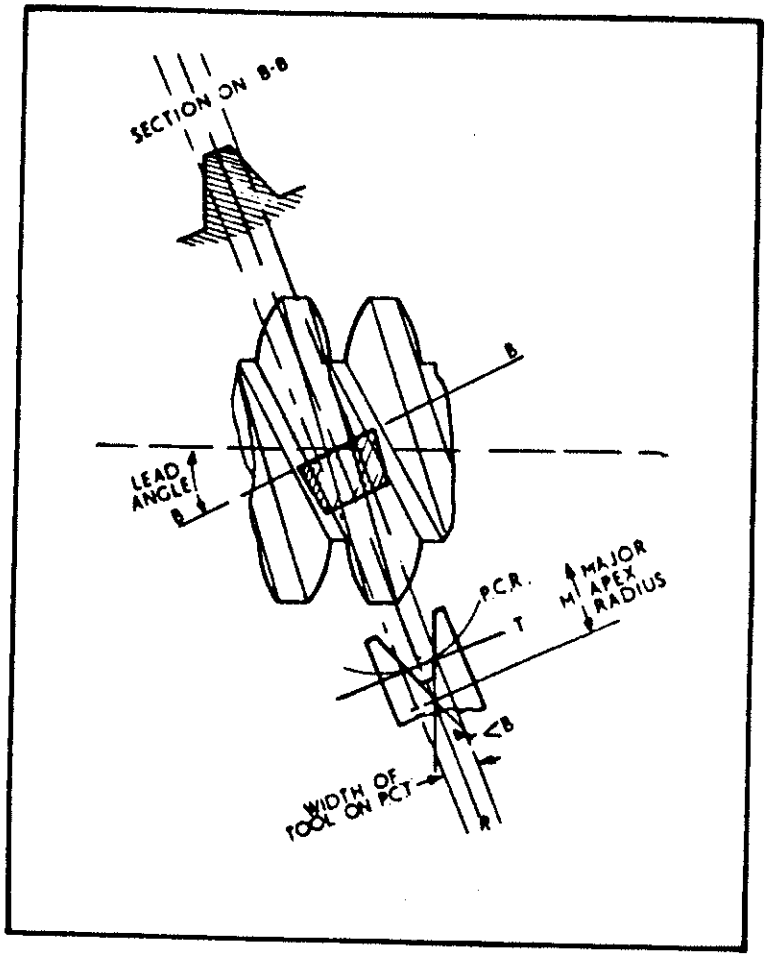


Fig. 2B

In the case of a thread as would be produced by an enveloping tool or chaser inclined at the lead angle, the radial line coincides with the centre line of the thread tooth and intersects the sharp edge which would be formed at the major diameter if the thread flanks were not truncated.

Fig. 2B Lathe worms produced by enveloping tool set normal to the helix.

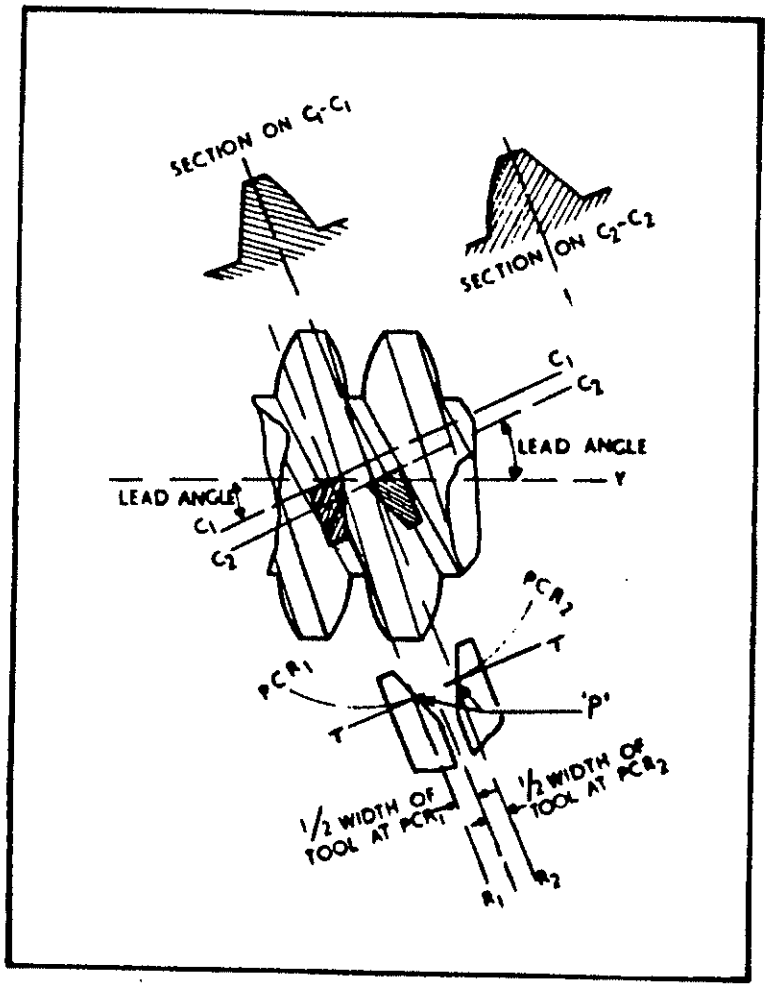
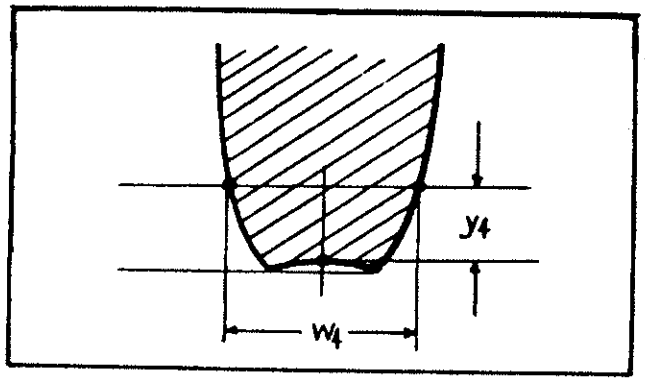


Fig. 2C

In the case of a thread as would be produced by a pair of halftools inclined at the lead angle; in this instance there are two radial lines, one for each flank and both in the same axial plane. The points 'P' on the tools coincide with the common intersection of the pitch cylinder -radial line- thread flank - axial plane and normal plane for the respective thread flanks.

Fig. 2C Lathe worms produced by halftools set normal to the helix.



Section of Grinding Wheel in plane containing axis of wheel.

Note 3: In cases (b) and (c) above; the theoretical width of the appropriate wheel forms, to finish-grind both flanks of the thread simultaneously, cannot easily be formulated. However, practical experience will show that the width at the tip of the wheel has to be considerably less than the required width of the space at the minor diameter of the thread. Actual trial will establish permissable widths of the wheel tip for the different types of thread forms and these dimensions should be noted on the 'Record Sheets', provided at the end of this section, for future reference. It is recommended that the wheel width be made less than the permissable maximum and the thread space is ultimately ground to required finished size by 'side-cutting'.

16. Wheels for Grinding Worm Form Crushing Rollers

Calculations for setting the dresser for this type of work are the same as for the corresponding form of thread to be produced (i.e. one of the formulae in paragraphs 13, 14 and 15).

NOTE: When dressing wheels for this purpose, the wheel is set to the appropriate thread lead angle and the change gears are those to give the axial lead of the thread.

DRESSER CAPACITY

17. There are four models of this type of generating dresser (i.e. 'Standard' 'SF1', 'SF2' and 'F234L') and each has a different capacity to cater for the particular requirements of the thread to be produced. Each model of the dresser has two alternative sets of holes for location of the centre bars and the diamond holder. The holes nearer to the swivel block pillar are designated the 'back holes'; those further from the pillar the 'front holes' (ref. Fig. 1).

18. The graph for each model of the dresser (at the end of this section) has four sets of curves 'A', 'B', 'C' and 'D' representing the possible zone of movement of the diamond at various values of Θ. The exact limits of the zones (curves X and Y) can be calculated from the formulae shown on the graphs.

NOTE: If Θ exceeds 45°, check by actual trial whether the setting is practicable.

19. The zone of movement of the diamond required by the work is calculated from the following formulae:

$$X = \sqrt{(\tfrac{1}{2}M)^2 - V^2} \qquad (X = \tfrac{1}{2}M \text{ when } V = 0.)$$

$$Y = \sqrt{(\tfrac{1}{2}m)^2 - V^2} \qquad (Y = \tfrac{1}{2}m \text{ when } V = 0.)$$

Where 'M' = Major diameter and 'm' = minor diameter

NOTE: If 'm' is less than 2V then 'Y' is taken as 0.

20. The calculated zone of movement of the diamond required by the work must fall within one of the zones shown on the graphs, with due allowance for over-travel, to ensure that the diamond will clear the wheel flank during dressing operations. If the required zone cannot be accommodated within one of the four zones on the appropriate graph, then the work is outside the capacity of that particular model of the dresser.

21. The combination of positions for the 'centre bars' and 'diamond holder' corresponding to the zones as shown on the graphs are as follows:

ZONE	CENTRE BARS	DIAMOND HOLDER
A	FRONT	BACK
B	FRONT	FRONT
C	BACK	BACK
D	BACK	FRONT

SETTING AND OPERATING INSTRUCTIONS (GENERAL THREADED WORK)

Prepare the machine as follows:

22. 'IMPORTANT NOTE'

Check that the 'Power to the Workhead Motor' is switched 'OFF' during all dressing operations.

23. Balance and mount the grinding wheel and set the wheelhead to the required helix angle.

24. Place the work or work-mandrel between the machine centres; set the tailstock position and check for parallelism of the workpiece to the table. Remove the work from the centres.

25. Select the appropriate pitch change gears; set the 'high/low range' selector lever on the gearbox to neutral; fit the manual pitching handle on the finally driven pitch change gear shaft.

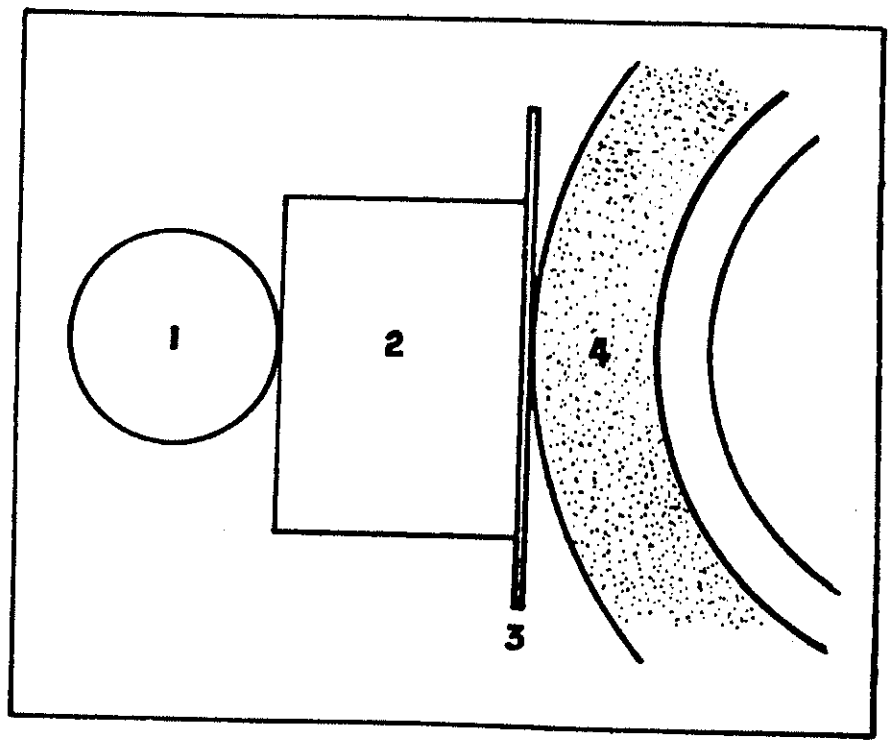


Fig. 3 Setting the wheel to grind the core radius.

(1) Long Centre Bar (2) Slip Gauge
(3) Feeler Gauge Protection (4) Grinding Wheel

Slip gauges required = 'Radius to be ground' - 'thickness of feeler gauge' - 'Radius of centre bar'.

26. Fit the recessed centre bars and the driving studs in the appropriate location holes in the generating dresser frame (refer to zone calculations).

27. Mount the dresser between the machine centres so that the unit is held with the lightest possible axial pressure without endplay. Adjust the driving carrier clamping screw to lightly hold the driving peg in the faceplate.

28. Fit the 'topping diamond' in the long centre bar, start the grinding wheel rotating, and true the periphery of the wheel, check that the width of the wheel is greater than the required finished size. Remove the 'topping diamond'.

29. Set the wheel to grind the required core radius of the work as follows: -

(a) When the required radius is greater than the centre bar radius, insert slip gauges with feeler gauge protection between the centre bar and the wheel periphery as shown in Fig. 3.

(b) When the core radius is less than the centre bar radius; using feeler gauge protection, move the wheel on to contact the centre bar and note the datum reading on the infeed handwheel scale. Retract the wheel and traverse the worktable so that the wheel will clear the centre bar. Infeed the wheel an appropriate amount past the datum reading on the handwheel scale.

i.e. Amount of wheel infeed past datum = '½ centre bar radius' plus 'feeler gauge thickness' minus '½ actual core diameter to be ground.'

(c) In certain extreme cases, when the tip width of the grinding wheel is large, the lead angle to which the wheel is set is large, and the minor diameter of the work is small, 'topping' of the wheel as described in paragraph 28 will produce appreciable concavity of the peripheral surface. In these cases a roller should be used in place of the 'feeler gauge', as described in setting procedures (a) and (b) above. The roller should be of sufficiently small a diameter to contact the lowest point of the wheel concavity.

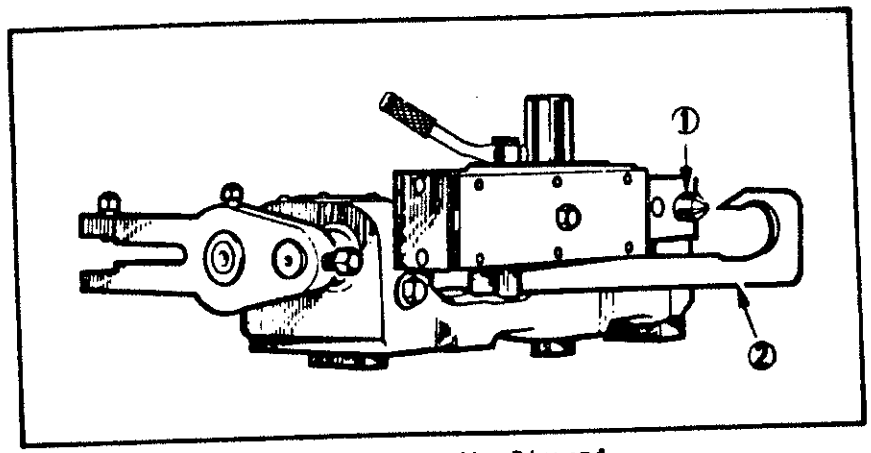


Fig. 4 Setting the Diamond

(1) Diamond and Holder (2) Setting Gauge

30. Setting the diamond

Stand the dresser on a surface plate, nip the diamond alignment 'setting gauge' (Fig. 4) between the swivel block and the frame of the dresser then tighten the padbolt screw to lock the swivel block in position. Fit the 'roughing' diamond in the appropriate horizontal hole in the slide head (refer to zone calculations). With the aid of a magnifying glass align the cutting point of the diamond with the tip of the setting gauge then tighten the screws in the slide head to secure the diamond holder. Re-check the alignment of the diamond cutting point; loosen the swivel block padbolt screw and remove the setting gauge.

31. Positioning of the Datum Peg

(a) Threads with straight flanks in the axial section:

For these types of threads the swivel block is set at the centre line height and therefore alternate flanks of the wheel can

be dressed simply by changing the position of the datum peg to the left hand or right hand location hole.

(b) Involute Helicoids:

(1) For a right hand helix thread, with the swivel block above centre line; the datum peg is located in the left hand hole for dressing the left hand flank of the wheel.

(2) For a left hand helix thread, with the swivel block above centre line; the datum peg is located in the right hand hole for dressing the right hand flank of the wheel (as shown in Fig. 1).

(c) Thread with straight flanks in section normal to the helix.

(1) For a right hand helix thread, with the swivel block above centre line; the datum peg is located in the right hand hole for dressing the right flank of the wheel.

(2) For a left hand helix thread, with the swivel block above centre line; the datum peg is located in the left hand hole for dressing the left hand flank of the wheel.

NOTE: With reference to (b) and (c) above, in each case the other flank of the wheel can be dressed by reversing the the dresser 'end for end' in the machine centres so that the swivel block is below the centre line height. The 'angle setting' and 'off-set' slip gauges are not disturbed during this operation but it is necessary to fit the driving carrier on the other centre bar also the slide actuating lever on the other squared end of the pinion shaft.

32. Setting the swivel block:

(a) For acme or worm threads with straight flanks in the axial section there is no 'off-set' of the swivel block i.e. the swivel block is positioned on the centre pillar with its lower face in contact with the machined boss on the frame casting. For all other types of threads, insert slip gauges to the value of 'V' beneath the swivel block.

(b) Insert 'angle setting' slip gauges to the value of 'C' between the datum peg and the sine arm; tighten the pad-bolt screw to lock the swivel block in position.

33. Mount the dresser between the machine centres (refer to para. 27) so that the diamond is adjacent to but clear of the appropriate flank of the wheel. Incline the dresser by manual rotation of the faceplate so that the line of diamond travel is initially clear of the wheel periphery and subsequent indexing of the faceplate, in the same direction of rotation as when grinding, will pass the diamond through an arc extending over the full width of the wheel flank.

i.e. For a right hand thread the dresser is inclined with the diamond downwards (as shown in Fig. 5) and the faceplate is indexed in an anti-clockwise direction. For a left hand thread, inclination of the dresser and rotation of the faceplate would be in the opposite direction.

Note: Record the initial inclined starting position of the diamond as shown on the faceplate index scale.

34. Check that the power to the workhead motor is switched 'OFF'.

35. Start the wheel rotating then move the worktable using the 'side-cut' control, until the diamond just skims the flank of the wheel.

36. Reciprocate the slide by operation of the pinion lever, ensuring that the diamond clears the wheel flank on each withdrawal stroke. Manually index the faceplate approximately 3° after each withdrawal stroke until the diamond has passed through an arc extending over the full width of the wheel flank.

Note: The faceplate must be indexed in the same direction of rotation as when grinding.

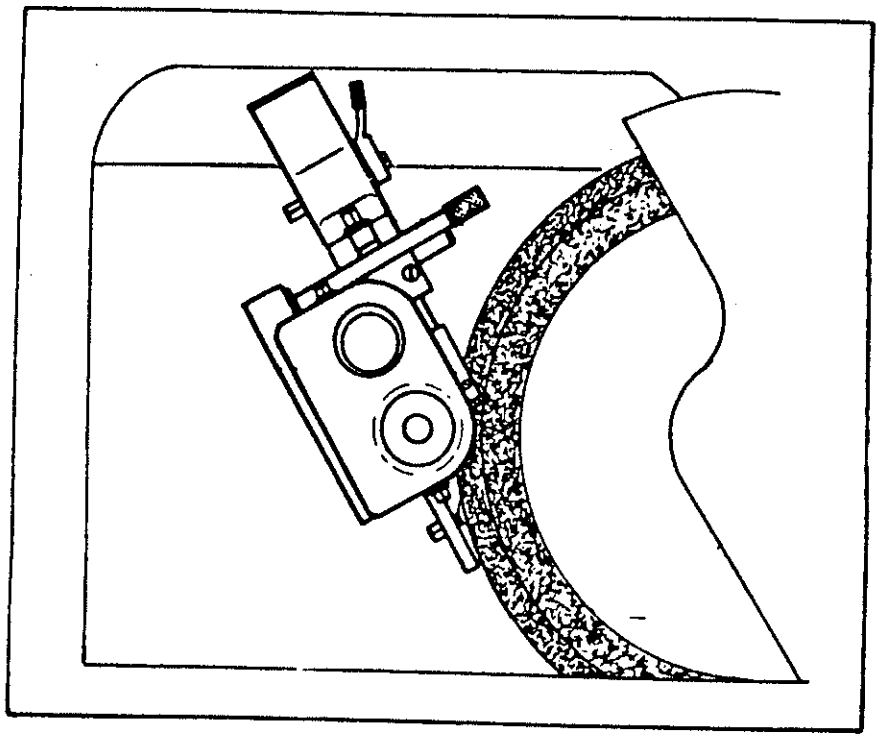


Fig. 5 Sectional view through tailstock centre, showing dresser inclined.

37. Return the dresser to its initial inclined starting position and advance the diamond 0.0005 inches to 0.002 inches (0.013 mm to 0.05 mm) towards the flank of the wheel using the 'side-cut' control. Dress the flank of the wheel as per paragraph 36. Repeat this procedure until the required form has been cut across the full width of the wheel flank. Check that the peripheral width of the wheel is above the required minimum.

38. Reverse the dresser in the machine centres, fit the driving carrier on the other centre bar and driving stud, also fit the actuating lever on the other end of the pinion shaft. Dress the other flank of the wheel as per paragraphs 33 to 37 inclusive.

NOTE: In the case of acme or threads with straight flanks in the axial section, the datum peg can be positioned in the other lubrication hole as per paragraph 31A. This avoids disturbing the dresser in the centres.

39. Remove the dresser from the machine and replace the 'roughing' diamond with the 'finishing' diamond in the same manner as described in paragraph 31, re-fit the slip gauges and secure the swivel block.

40. Mount the dresser between the machine centres as per paragraphs 27 and 33. Dress the wheel as described in paragraphs 34 to 38 inclusive. On final dressing of the second flank, the wheel peripheral width should be reduced to the required finished size.

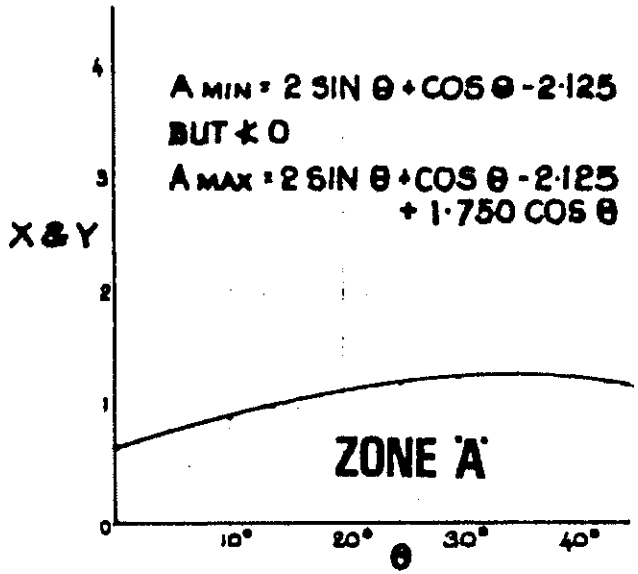
41. Retract the wheel and switch off power. Remove the dresser from the machine centres and mount the workpiece ready for grinding operations.

NOTE: During all dressing operations the wheel infeed must be set to the required core radius of the work also the wheel infeed must return to this setting before commencement of final grinding operation in order to obtain the correct thread profile.

$A_{MIN} = 2 \sin\theta + \cos\theta - 2{\cdot}125$

BUT < 0

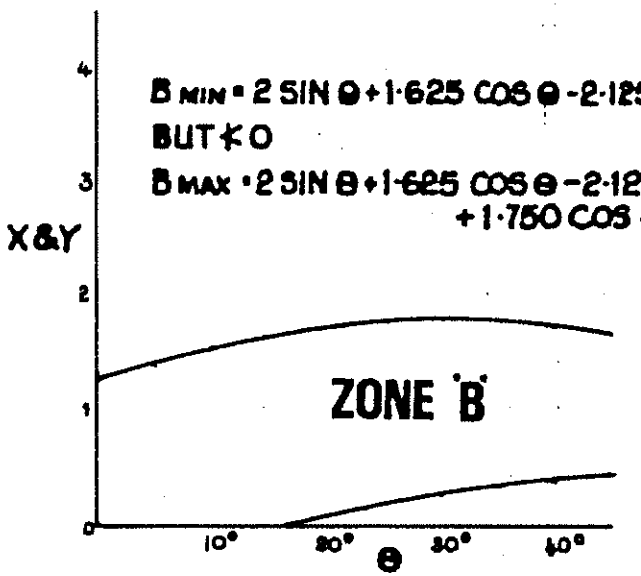
$A_{MAX} = 2 \sin\theta + \cos\theta - 2{\cdot}125 + 1{\cdot}750 \cos\theta$



$B_{MIN} = 2 \sin\theta + 1{\cdot}625 \cos\theta - 2{\cdot}125$

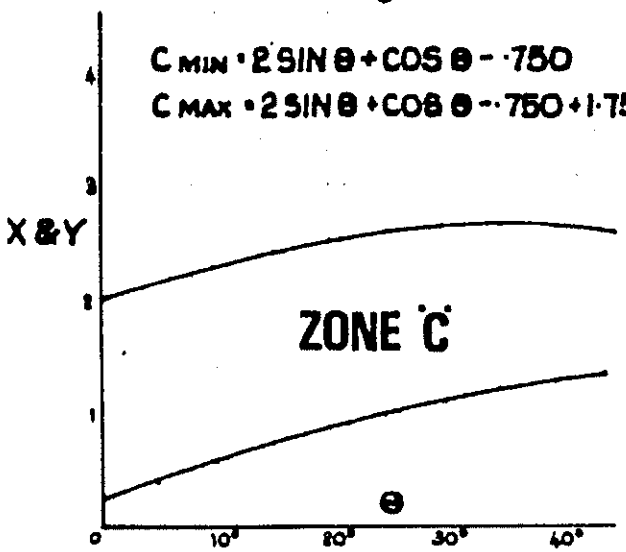
BUT < 0

$B_{MAX} = 2 \sin\theta + 1{\cdot}625 \cos\theta - 2{\cdot}125 + 1{\cdot}750 \cos\theta$



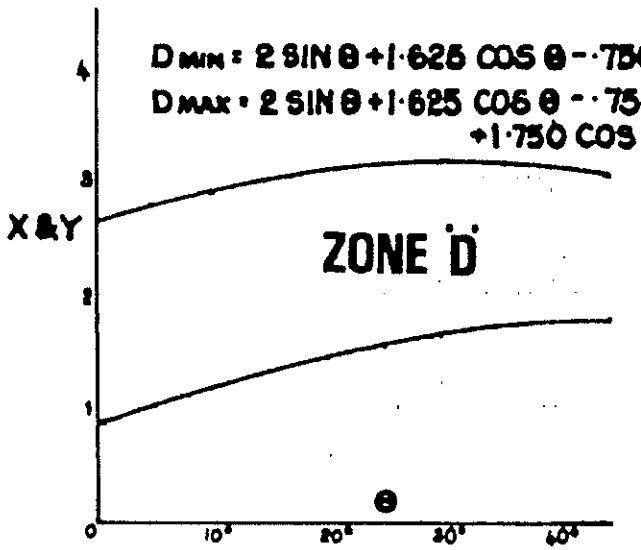
$C_{MIN} = 2 \sin\theta + \cos\theta - {\cdot}750$

$C_{MAX} = 2 \sin\theta + \cos\theta - {\cdot}750 + 1{\cdot}750 \cos\theta$



$D_{MIN} = 2 \sin\theta + 1{\cdot}625 \cos\theta - {\cdot}750$

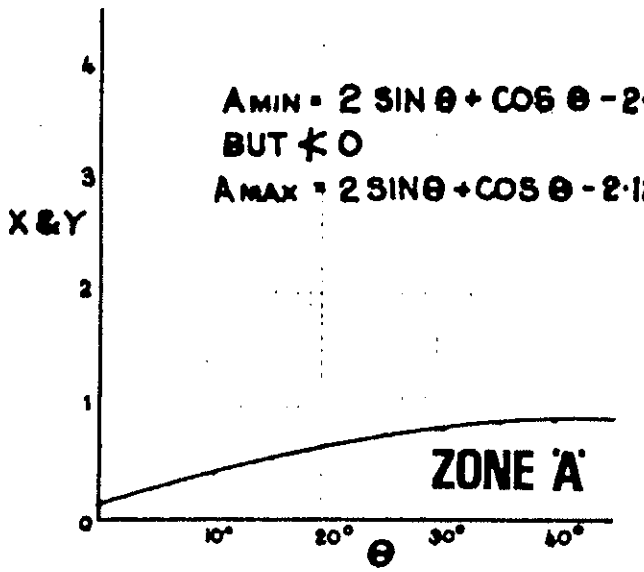
$D_{MAX} = 2 \sin\theta + 1{\cdot}625 \cos\theta - {\cdot}750 + 1{\cdot}750 \cos\theta$



$A_{MIN} = 2 \sin\theta + \cos\theta - 2{\cdot}125$

BUT $\not< 0$

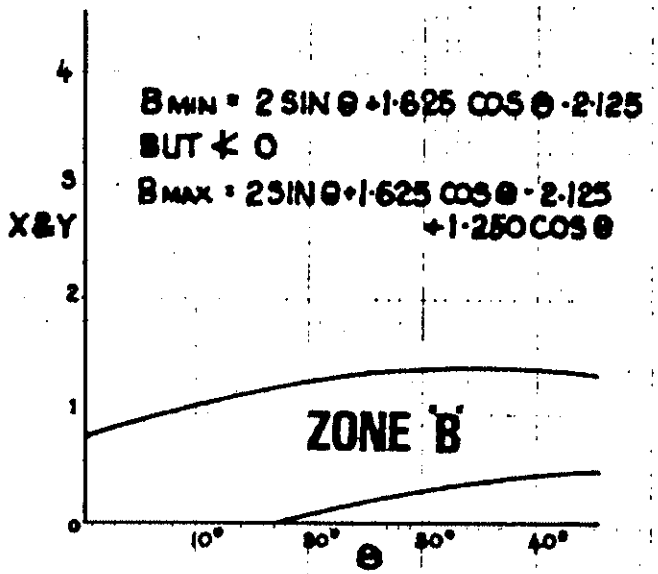
$A_{MAX} = 2\sin\theta + \cos\theta - 2{\cdot}125 + 1{\cdot}250\cos\theta$



$B_{MIN} = 2\sin\theta + 1{\cdot}625\cos\theta - 2{\cdot}125$

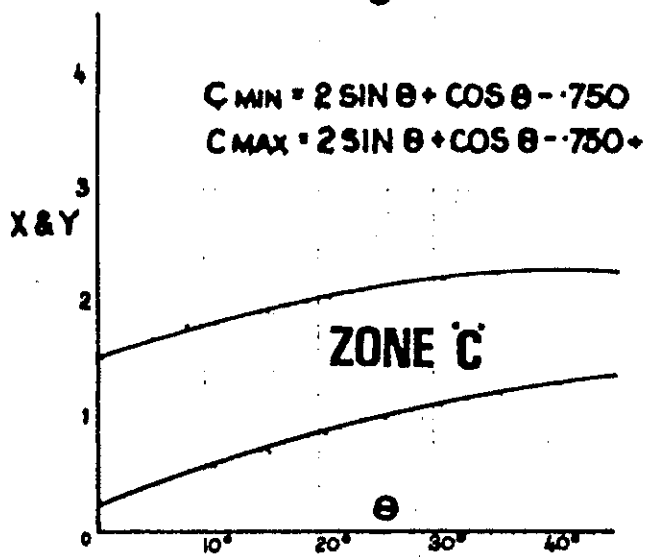
BUT $\not< 0$

$B_{MAX} = 2\sin\theta + 1{\cdot}625\cos\theta - 2{\cdot}125 + 1{\cdot}250\cos\theta$



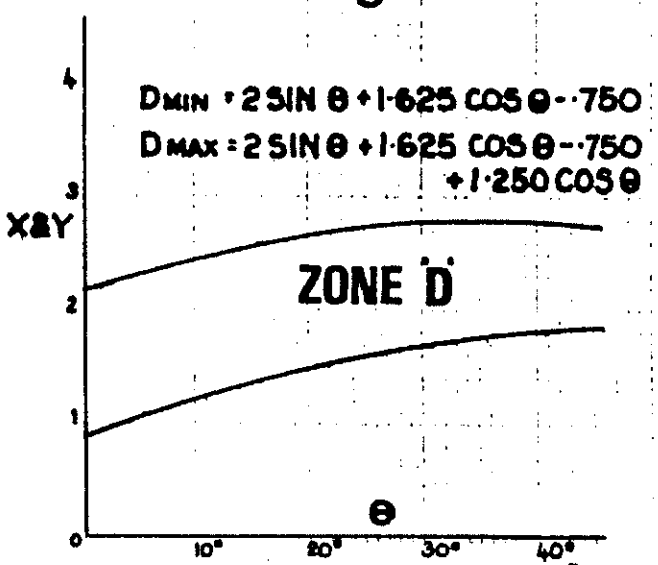
$C_{MIN} = 2\sin\theta + \cos\theta - {\cdot}750$

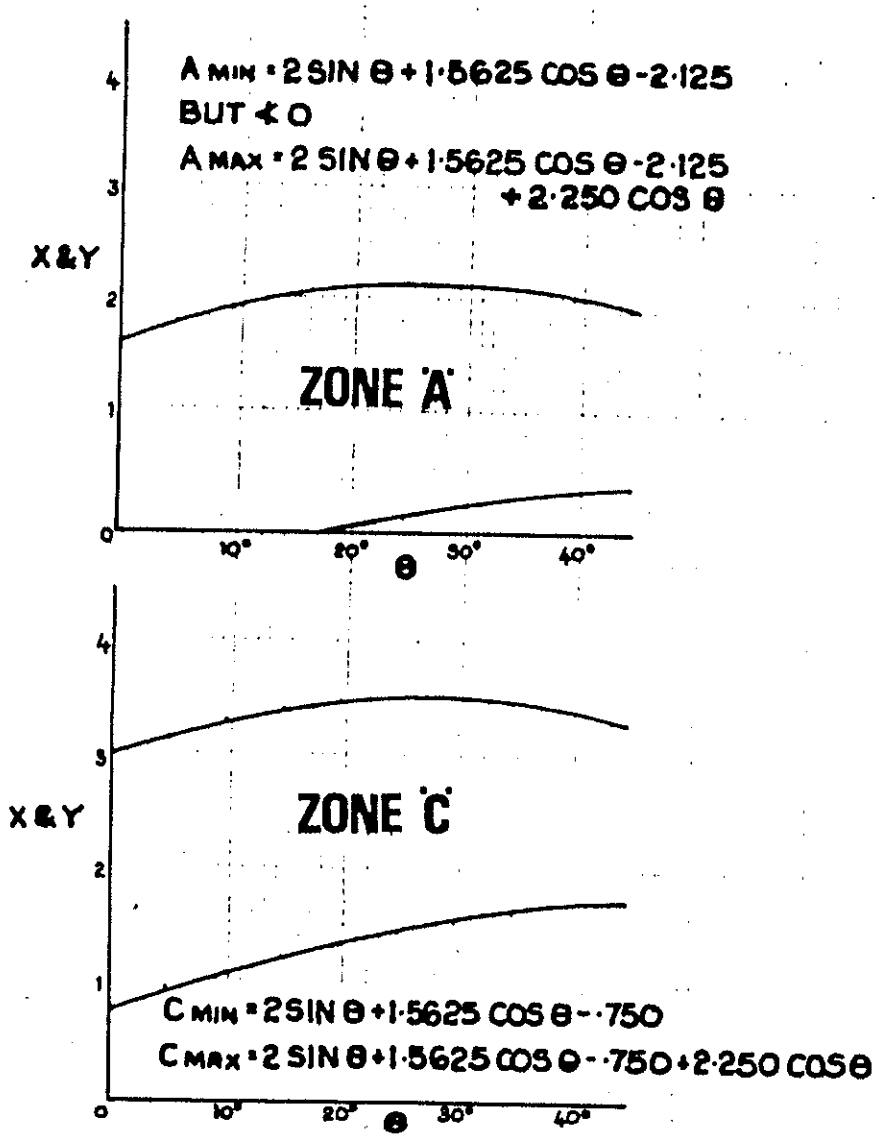
$C_{MAX} = 2\sin\theta + \cos\theta - {\cdot}750 + 1{\cdot}250\cos\theta$

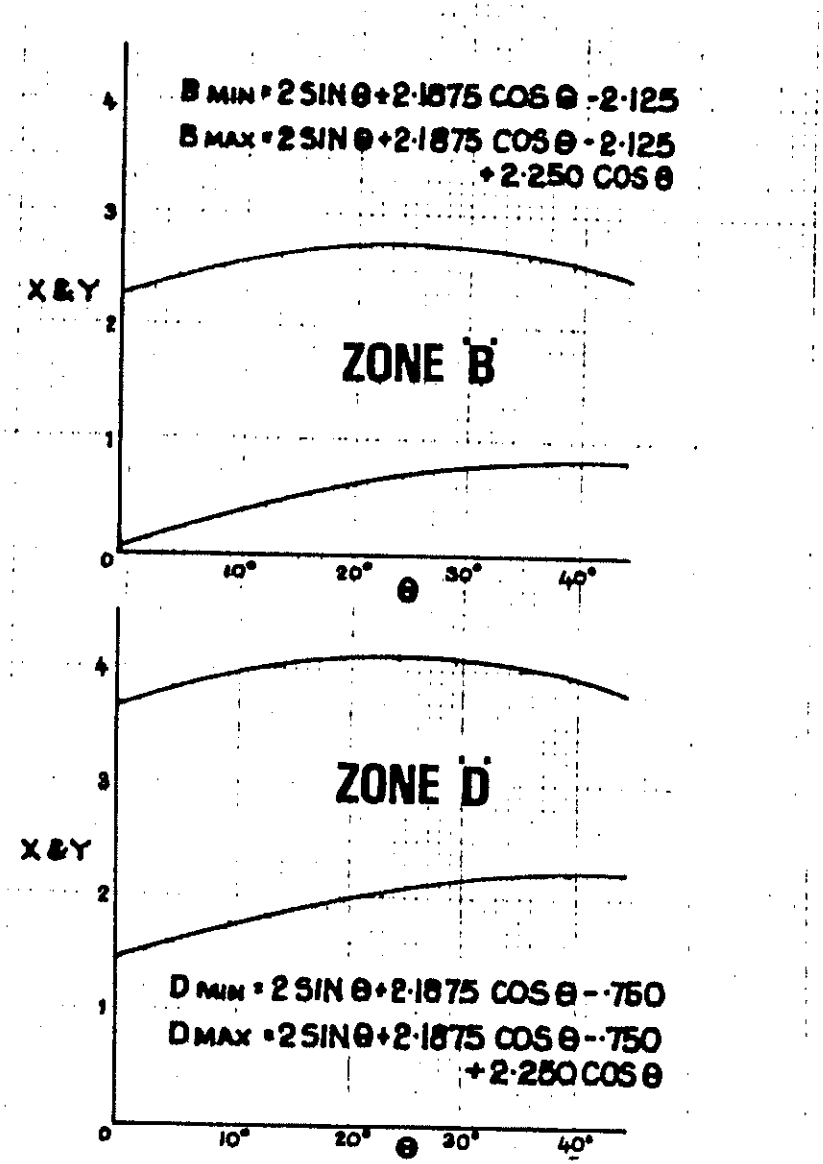


$D_{MIN} = 2\sin\theta + 1{\cdot}625\cos\theta - {\cdot}750$

$D_{MAX} = 2\sin\theta + 1{\cdot}625\cos\theta - {\cdot}750 + 1{\cdot}250\cos\theta$




A MIN = 2 SIN θ + 1·5625 COS θ - 2·125
BUT < 0
A MAX = 2 SIN θ + 1·5625 COS θ - 2·125 + 2·250 COS θ
X & Y
ZONE 'A'
θ
10°
20°
30°
40°
C MIN = 2 SIN θ + 1·5625 COS θ - ·750
C MAX = 2 SIN θ + 1·5625 COS θ - ·750 + 2·250 COS θ
ZONE 'C'

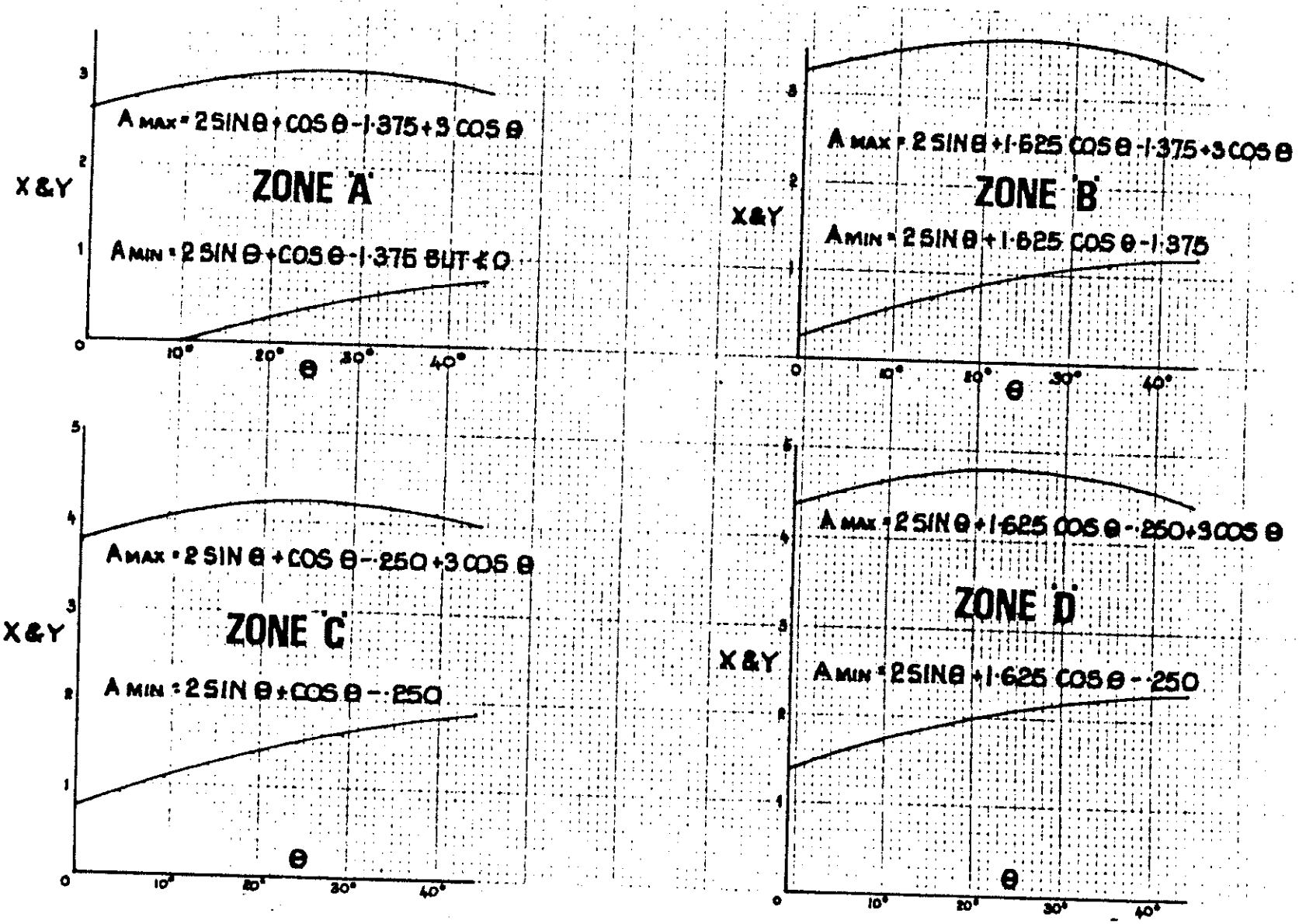

B MIN = 2 SIN θ + 2·1875 COS θ - 2·125
B MAX = 2 SIN θ + 2·1875 COS θ - 2·125 + 2·250 COS θ
X & Y
ZONE 'B'
θ
10°
20°
30°
40°
D MIN = 2 SIN θ + 2·1875 COS θ - ·750
D MAX = 2 SIN θ + 2·1875 COS θ - ·750 + 2·250 COS θ
ZONE 'D'

MATRIX Record Sheet

Gauge sizes and wheel widths

11246 Generating Dresser

Job Reference	Zone	'OFFSET' (V) Slip Gauge	Angle Setting (C) Slip Gauge	Width of wheel form		Helix Angle
				'W'	'Y'	


A MAX = 2 SIN θ + COS θ - 1·375 + 3 COS θ
ZONE 'A'
A MIN = 2 SIN θ + COS θ - 1·375 BUT ≤ 0
X & Y
θ
A MAX = 2 SIN θ + 1·625 COS θ - 1·375 + 3 COS θ
ZONE 'B'
A MIN = 2 SIN θ + 1·625 COS θ - 1·375
A MAX = 2 SIN θ + COS θ - ·250 + 3 COS θ
ZONE 'C'
A MIN = 2 SIN θ + COS θ - ·250
A MAX = 2 SIN θ + 1·625 COS θ - ·250 + 3 COS θ
ZONE 'D'
A MIN = 2 SIN θ + 1·625 COS θ - ·250

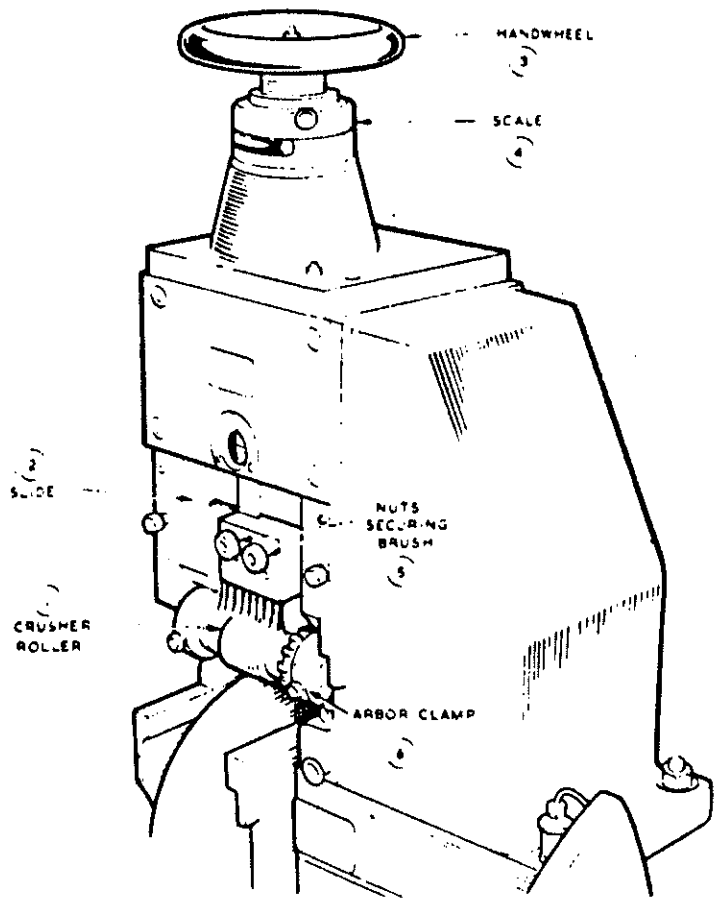


Fig. 1 16 GMC Crusher Unit

16 GMC MULTI-RIBBED WHEEL CRUSHER

INTRODUCTION

1. The 16 GMC crusher unit is located on the machine attachment mounting by a square key and secured by four retaining bolts. The unit is manually operated; the crushing roller being fed into the wheel by the graduated handwheel mounted at the top of the unit.

2. The crushing roller is mounted to an arbor located in roller bearings, the arbor being mounted to the unit by two half clamps and securing nuts; located by removing the detachable front cover plate. A wire brush is mounted above the crushing roller, this must be adjusted by means of the two knurled retaining nuts to maintain the brush in contact with the crushing roller. Crushing rollers are readily interchangeable and are available in Whitworth, BA, AN, UN or SI thread forms.

3. A vertical scale, (visible through the window at the front of the unit), facilitates rapid positioning of the crushing roller, each division on the scale indicates a 1/16 in. (1.59 mm) feed increment.

MOUNTING THE UNIT

4. (a) If the grinding wheel is mounted, the crushing roller should be wound clear to its fullest extent to prevent it fouling the wheel when the unit is mounted.

   (b) Mount the unit to the attachment face, ensuring that the square key at the base of the unit is correctly located.

(c) Couple the flexible coolant supply hose to the rear of the unit and to the tee connection adjacent to the coolant control stopcock.

MOUNTING THE CRUSHING ROLLER

5. (a) Remove the detachable front cover from the unit together with the wire cleaning brush.

(b) Locate the crushing roller and its mounting arbor, ensure that both are thoroughly clean and lightly lubricate both the arbor and roller bore.

(c) Mount the roller to the arbor and secure the assembly using the 'C' spanners provided.

(d) Locate the arbor assembly in the unit and secure the retaining clamps. Clean and replace the wire brush.

(e) If the wheel form has been previously roughed out, the roller must be adjusted to locate the ribs in the pre-roughed grooves on the wheel.

(f) When crushing a plain wheel the crushing roller should be adjusted to produce a complete thread on each edge of the wheel. In certain instances this may not be possible, in such cases partial threads on the edge of the wheel can be eliminated by dressing the flanks prior to crushing (see Fig. 2). It is important that half threads are removed from the wheel or serious breakage will occur.

TRUING THE WHEEL

6. Prior to crushing, the periphery of the wheel must be dressed with a keen diamond mounted in the wheel truer. Crushing imparts the wheel form only and will not true the wheel.

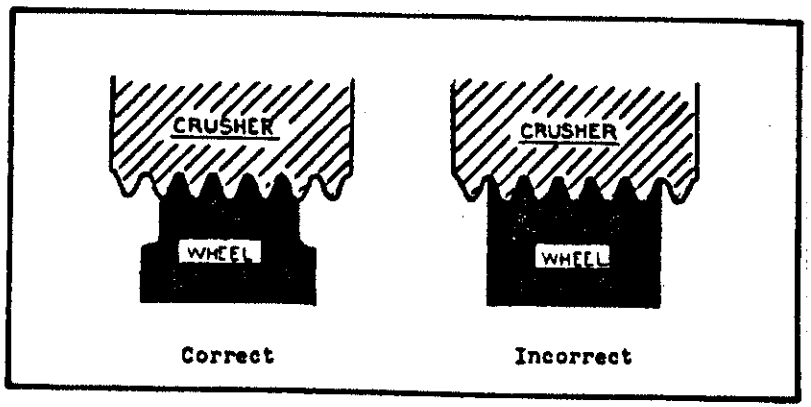


Fig. 2 Wheel Form.

CRUSHING THE WHEEL

7. (a) Rotate the grinding wheel slowly by hand, feeding the crushing roller down towards the wheel until it is felt to 'bite'. Note the reading on the visual feed indicator.

(b) Loosen the handwheel scale lockscrew, set the scale at zero and re-lock the screw.

(c) 'Wind off' the roller.

(d) Select 'Continuous' coolant. Close the main coolant stop cock and open the auxilliary supply to the crusher unit.

(e) Select 'Hand Crushing' on the 'WHEELHEAD' selector switch. Press the 'Master Start' on the control station.

(f) Advance the crushing roller to the previous visual indicator feed reading and commence a steady continuous feed; sufficient to maintain the roller continually biting into the surface of the wheel.

(g) Continue to 'crush' until the required infeed figure is attained on the handwheel scale and immediately withdraw the crushing roller from the wheel.

WARNING: DO NOT allow the crushing roller to idle in contact with the wheel without positive feed being applied.

(h) 'Wind off' the feed handwheel by a definite number of graduation on the lower scale.

16 GMB AUTOMATIC MULTI-RIBBED WHEEL CRUSHER

GENERAL

8. The 16 GMB unit is mounted to the wheelhead attachment face and apart from depth of feed settings is fully automatic in operation. The unit may be employed for manual, continuous automatic or single cycle automatic operations as selected by the lever on the left hand side of the unit.

Manual Crushing
The crushing roller is fed into and withdrawn from the wheel utilising the manual feed handwheel, Fig. 3 (4).

Continuous Automatic Crushing
The crushing roller is fed progressively into the wheel by predetermined increments of .001 to .004 in. (.025 to .125 mm) until the master stop button is pressed.

Single Cycle Automatic Crushing
The crushing roller is fed automatically into the wheel by predetermined increments of .001 to .004 in. and stops when this depth is attained.

9. The crushing roller is mounted in needle roller bearings on an arbor, the assembly being retained in the base of the crusher unit by two half clamps. Vertical movement of the crusher unit

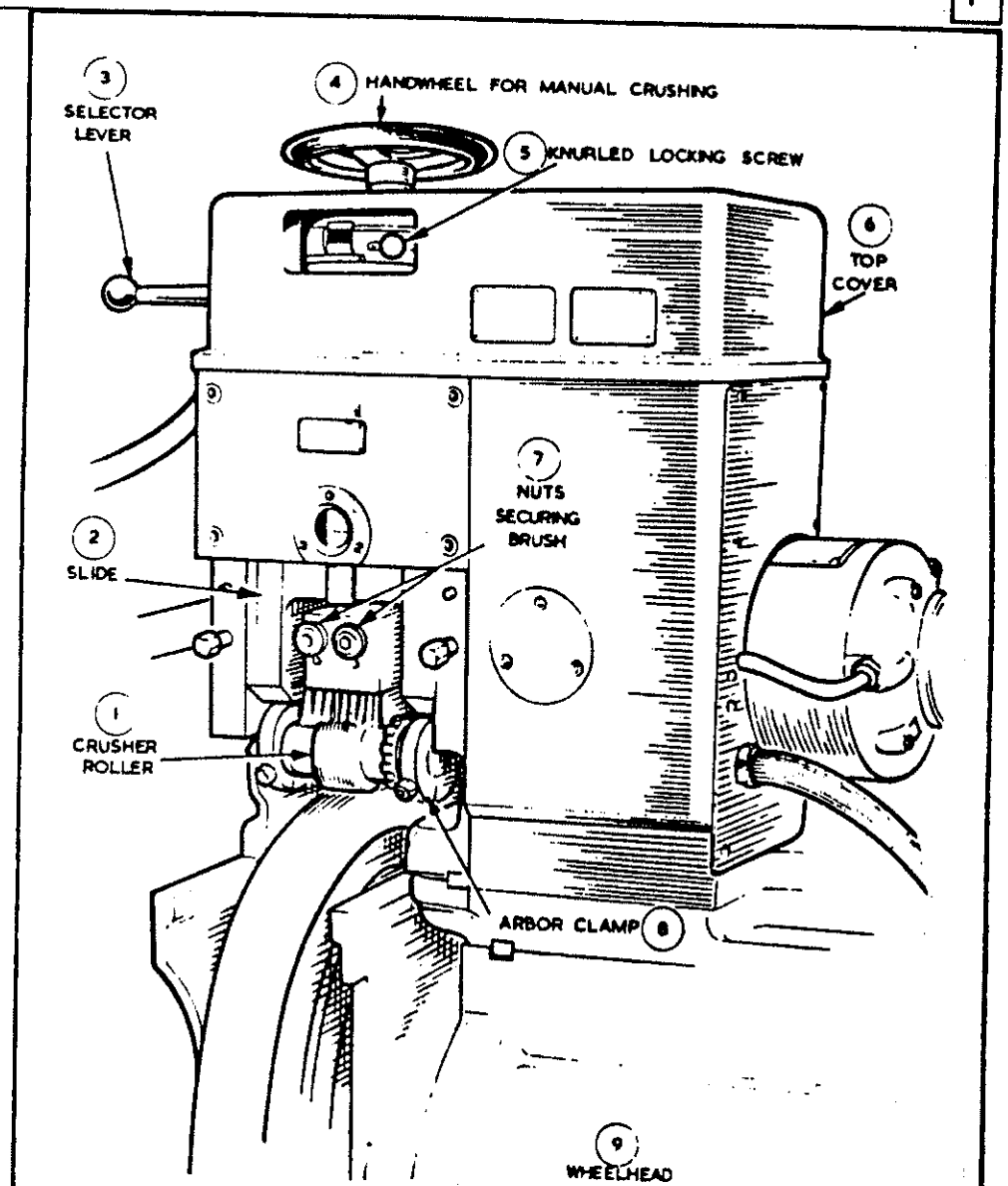


Fig. 3 16 GMB Crusher Unit

slide is effected by a feedscrew and nut attached to the slide. A handwheel splined to the top of the feed screw facilitates manual feed. A ratchet, also splined to the feed screw is encompassed by a shroud having two apertures, the front aperture housing two scales. The upper scale which is integral with the ratchet is graduated with divisions which indicate infeed increments of .001 in. The lower scale divisions are marked 1 - 4, the number indicated by the small red arrow on the shroud being the total infeed in thousandths of an inch per automatic cycle. To set this infeed, release the knurled lockscrew (5) and move the shroud until the required infeed is indicated, re-lock the screw.

10. The vertical scale visible through the window at the front of the unit provides an approximate indication of total infeed. Each division on this scale indicating 1/16 in. (1.59 mm).

11. Removing the handwheel and top cover will reveal the cycle cam which is rotated by the 0.1 H.P. unit motor. Also visible is a pawl mounted to the cam follower; when the shroud arrow indicates zero the pawl locates the periphery of the shroud. Rotation of the shroud i.e. setting the feed increment, allows the pawl to engage the ratchet and the number indicated by the arrow equals the number of teeth visible in the front of the ratchet. Movement of the cam follower by the cam causes the pawl to advance the distance encompassed by this number of teeth, thereby rotating the feedscrew the required amount to achieve the selected infeed cycle. Crushing deeper than the maximum permitted is obviated by an 'ultimate' switch which cuts out the unit motor.

IMPORTANT: Re-crushing results in wheel diameter decrement; the wheelhead must therefore be advanced after re-crushing by the total sum of crushing increments per cycle, the first workpiece subsequent to re-crushing should be checked for possible error in form depth caused by the 'breakdown' of the wheel form structure.

CRUSHER MOUNTING

12. If the grinding wheel is mounted, set the shroud so that the small red arrow indicates zero on the scale, tighten the lockscrew (5) and 'wind off' the feed to prevent the crushing roller making contact with the wheel when mounting the unit.

13. Remove the feed handwheel and crusher unit top cover. Extract the two screws in the top face of the unit and substitute two ½ in. Whitworth eyebolts. Attach lifting tackle and hoist the unit into position on wheelhead mounting studs. Ensure that the unit is correctly positioned on the square locating key. Secure the unit retaining nuts.

14. Remove the dummy plug from the electrical cabinet and insert the crusher unit plug. Couple the flexible coolant hose to the rear of the unit and to the 'tee' connection adjacent to the main supply stop cock. Replace the top cover plate and handwheel.

MOUNTING THE CRUSHING ROLLER

15. Remove the crusher unit front cover plate; release the two knurled nuts and remove the wire cleaning brush. Select the required crushing roller and mounting arbor, ensure that both are thoroughly clean and apply light lubrication to both the arbor and bore of the roller. Assemble the crushing roller and arbor using the 'C' spanners provided and mount the assembly in the crusher unit, replace the two half retaining clamps and wire cleaning brush. Replace the front cover plate.

TRUING THE WHEEL

16. Prior to crushing, the periphery of the wheel should be dressed with a keen diamond mounted in the wheel truer. The crushing operation imparts the wheel form only and will not true the wheel.

MANUAL CRUSHING

17. (a) Position the selector lever Fig. 3 (3) at 'MANUAL CRUSHING'.

(b) Select 'HAND CRUSHING' on the machine control station.

(c) Wind on the feed handwheel (4) until the crushing roller is felt to 'bite' the wheel, continue winding on until a positive resistance is felt.

(d) Select 'CONTINUOUS' coolant and open the auxilliary supply to the crushing roller.

(e) Press the control station master 'START' and immediately commence feeding the crushing roller into the wheel. When the required depth of feed is attained the selector lever should be placed in the 'AUTO CRUSHING' position, this will cause the roller to be retracted from the wheel in preparation for 'SINGLE CYCLE AUTO' crushing.

CONTINUOUS AUTO CRUSHING

18. Setting the automatic feed; cycles are intermittent and controlled by the cycle cam in the top of the unit. Feed increments are variable from .001 to .004 in. (.025 to .102 mm) per cycle, the required increment being pre-set by releasing the lockscrew Fig. 3 (5) and rotating the shroud until the red arrow indicates the required increment. The lockscrew should then be secured. Operation is effected as follows.

(a) Position the selector levet at 'CONTINUOUS AUTO CRUSHING'.

(b) Select 'AUTO CRUSHING' on the machine control station.

(c) Set the required feed increment.

(d) Select 'CONTINUOUS' coolant and open the auxilliary supply to the crushing roller.

(e) Press the control station master 'START' and manually wind on the feed until the roller is felt to 'bite' the wheel, at this point the auto cycle will commence, and will be repeated until discontinued by placing the selector lever at 'SINGLE AUTO CYCLE'. On completion of this cycle the crushing roller will be retracted in preparation for subsequent re-crushing operations.

SINGLE CYCLE AUTO CRUSHING

19. (a) Place the selector lever in the 'SINGLE CYCLE AUTO' position.

(b) Select 'AUTO CRUSHING' on the machine control station.

(c) Set the required feed increment.

(d) Select 'CONTINUOUS' coolant and open the coolant supply to the crusher unit.

(e) Press the master 'START' button on the control station, the crushing roller will be fed into the wheel and automatically retracted at the end of the cycle.

NOTE: Prior to 'SINGLE CYCLE AUTO' crushing it may be necessary to feed the crushing roller manually to make contact with the wheel, after which 'SINGLE CYCLE AUTO' may be selected and performed as above.

NOTES

20. Never use soluble coolant oil.
When re-crushing the wheel remove only the amount necessary to restore the wheel form. Usually .002 to .003 in. (.05 to .075 mm) will be sufficient. The smaller the amount removed at each re-crush the longer the life of the crushing roller and the better the wheel cutting action. When producing coarse pitches it is recommended that the wheel form should be 'roughed out' with a 'vee' diamond prior to crushing.

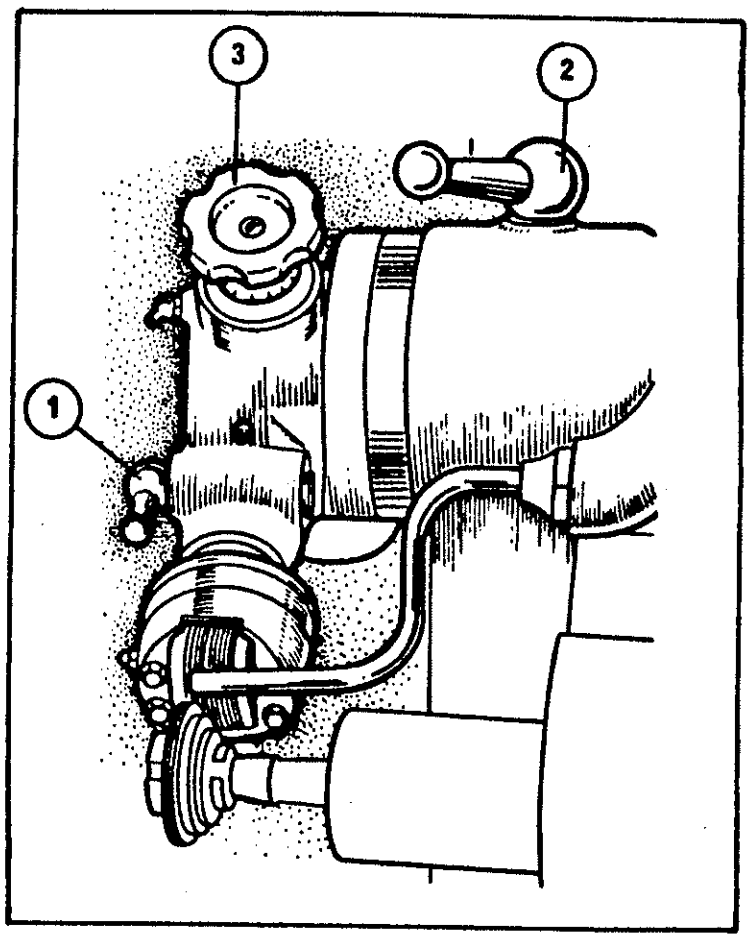


Fig. 4 VTB/1 Internal Wheel Crusher

VTB/1 CRUSHER UNIT (INTERNAL)

INTRODUCTION

21. The VTB/1 internal wheel crusher is mounted to the common pivot attachment which also accepts the internal single point dresser unit. The pivot attachment is first mounted to the internal attachment face and the crusher head secured in the attachment barrel slide by the locking lever Fig. 4 (1). When in the operating position the unit is arrested by a stop and secured by the locking lever (2), by releasing the lever the unit is swung clear of the wheel for grinding operations. Two retaining nuts secure the crusher head to the barrel slide and feed is effected by the micrometer graduated feed knob (3).

22. Crushing rollers are interchangeable on the mounting arbor and run in precision bearings, the arbor being retained in the crusher head by two clamp blocks and retaining nuts. A wire cleaning brush is incorporated in the barrel slide, ensure that this is always in position and not unduly worn.

MOUNTING THE CRUSHING ROLLER

23. (a) Select the required crushing roller.

(b) Remove the four retaining nuts and the arbor clamps and remove the crusher and arbor assembly from the head.

(c) Remove the crushing roller retaining nut, utilising the 'C' spanner provided.

(d) Slide the crushing roller from the arbor and smear with light machine oil.

(e) Mount the selected crushing roller on the arbor and replace the retaining nut.

(f) Mount the assembly to the crusher head, replace the arbor clamps and retaining nuts.

PREPARATION FOR CRUSHING

24. It is essential that the periphery of the wheel should be true prior to crushing. To obtain this condition it will be necessary to mount the wheel truer and traverse a plain truing diamond across the wheel in a similar manner to that employed for external wheels. Prior to the initial crushing of coarse pitches it is recommended that the form should be roughed out with a 'vee' diamond mounted in the wheel truer; this will relieve unnecessary strain on the wheel spindle.

CRUSHING THE WHEEL

25. (a) Swivel the unit down to the arresting stop and secure the locking lever.

(b) Operate the feed control to advance the crushing roller until it is just clear of the wheel.

(c) If the wheel form has been pre-roughed, adjust the crushing roller to align the wheel ribs.

(d) Rotating the wheel slowly by hand advance the crushing roller until it can be felt to 'bite' the wheel.

(e) Select 'CONTINUOUS' coolant and position the wheelhead switch at 'HAND CRUSHING'.

(f) Press the master 'Start' and immediately commence to feed the crushing roller into the wheel; on reading the required depth of feed the crushing roller must be immediately retracted.

WARNING: It is important that the crushing roller should not be allowed to idle in contact with the wheel.

(g) Release the attachment locking lever and swing the unit clear of the wheel.

NOTES

26. Always maintain the cleaning brush in good condition. Charge all lubrication nipples regularly, paying particular attention to the arbor bearing nipple. When re-crushing a used wheel remove only the amount necessary to restore the wheel form, usually .002 - .003 in. (.050 - .075 mm) will be sufficient.

SELECTING THE WHEEL.

1. The following notes are intended to guide the operator in the selection of a suitable grinding wheel.

GRINDING WHEEL TERMINOLOGY

2. 'ABRASIVE' - the cutting or grinding substance of the wheel.
'BOND' - the substance or manufacturing process employed which holds the abrasive particles together.
'GRIT' or 'GRAIN' - the size of the abrasive particles.
'STRUCTURE' - the spacing of the 'GRIT' or 'GRAIN'.
'GRADE' - the apparent degree of wheel hardness, resulting from the density with which the abrasive particles are bonded. (Not to be confused with the actual hardness of the abrasive particles).

3. Wheel structure must be such that it will permit the necessary free cutting action for diamond dressing and/or crushing. Wheels comprising a 'Vitrified' bond are considered to be superior for thread grinding operations, the following qualities having influenced this decision:

(a) Availability in various grits and grades.
(b) Rapid stock removal without overheating.
(c) Inflexible under pressure, and
(d) Wheel porosity, which allows the coolant oil to be used with maximum advantage.

4. The wheel hardness must suit the type of work envisaged, also, the grit must be small enough to permit the wheel form to be maintained.

WHEEL MOUNTING.

5. The 'MATRIX' wheel adaptors supplied with the machine guarantee rigidity and safe running, other types of adaptor should never be used. Always ensure that the correct adaptor is used in accordance with the thickness of wheel to be mounted. Wheel thicknesses and corresponding adaptors are listed below and relate to wheels of 16 in. (406 mm) diameter and 8 in. (203 mm) bore.

WHEEL		ADAPTOR	
Thickness	Recess	Size	Ref.
½ in. (13 mm)	-	½ in. (13 mm)	D.103.CC.
¾ in. (19 mm)	-	¾ in. (19 mm)	D.103.CD.
1 in. (25 mm)	-	1 in. (25 mm)	D.103.CE.
1½in. (38 mm)	½ in. (13 mm)	1 in. (25 mm)	D.103.CE.
1¾in. (44 mm)	¼ in. (6 mm)	1½in. (38 mm)	D.103.CF.
2 in. (50 mm)	½ in. (13 mm)	1½in. (38 mm)	D.103.CF.
2¼in. (58 mm)	¾ in. (19 mm)	1½in. (38 mm)	D.103.CF.
3 in. (76 mm)	1½in. (38 mm)	1½in. (38 mm)	D.103.CF.

6. The adaptor assembly comprises the adaptor, on which the wheel is mounted, a clamping plate and six retaining screws. In addition to clamping the wheel the plate abuts a shoulder on the adaptor Fig. 1 (A) preventing distortion and adding rigidity to the wheel assembly.

NOTE: Do not use excessive torque when tightening the adaptor screws or the clamp plate will eventually become 'dished' rendering the assembly unsafe.

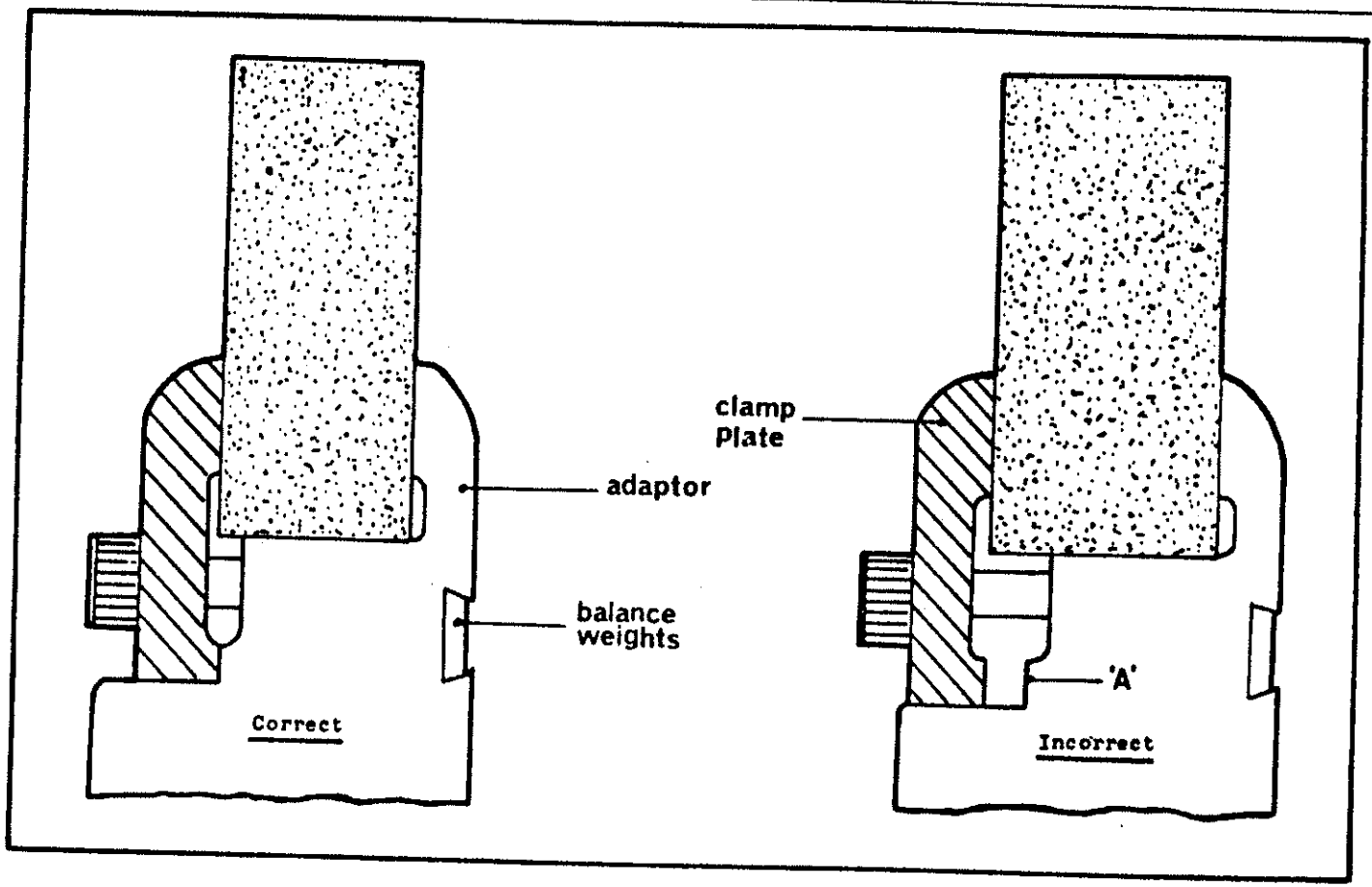


Fig. 1 Wheel Mounting

ADAPTOR SCREW TIGHTENING SEQUENCE

7. Remove paper on other washers from the sides of the wheel, mount the wheel to the adaptor flange and locate the clamp plate. Tighten the six securing screws in the sequence shown in Fig. 2.

BALANCING

8. For the production of accurate components it is essential that the wheel assembly is correctly balanced prior to the commencement of any grinding operations. Balancing may be effected by either of the following methods.

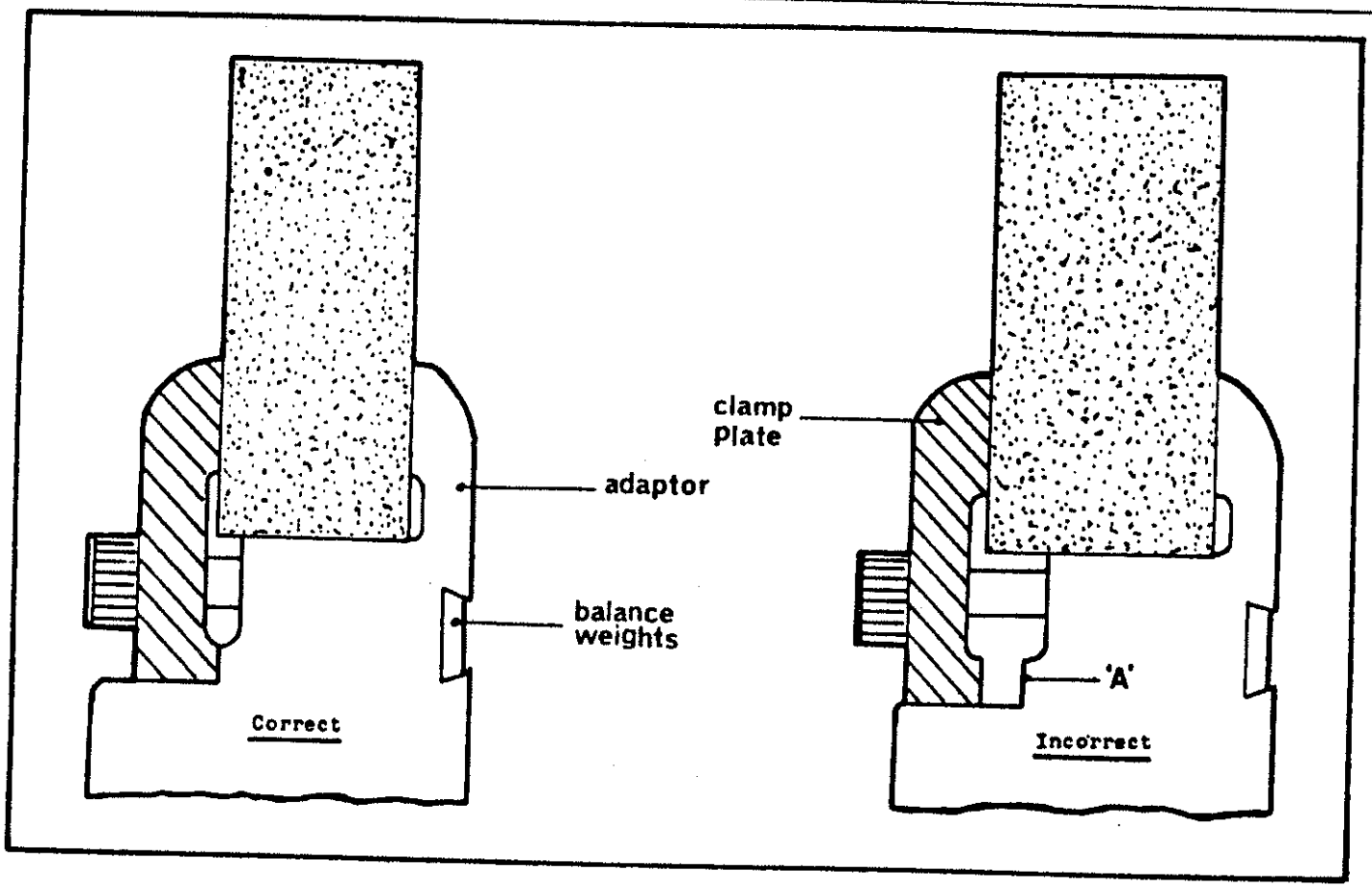


Fig. 1 Wheel Mounting

ADAPTOR SCREW TIGHTENING SEQUENCE

7. Remove paper on other washers from the sides of the wheel, mount the wheel to the adaptor flange and locate the clamp plate. Tighten the six securing screws in the sequence shown in Fig. 2.

BALANCING

8. For the production of accurate components it is essential that the wheel assembly is correctly balanced prior to the commencement of any grinding operations. Balancing may be effected by either of the following methods.

(a) Static wheel balancing, which utilises the balancing fixture ref. WB, the wheel assembly being balanced prior to mounting on the wheelhead, or

(b) Dynamic balancing, the wheel being balanced 'in situ' on the wheelhead spindle.

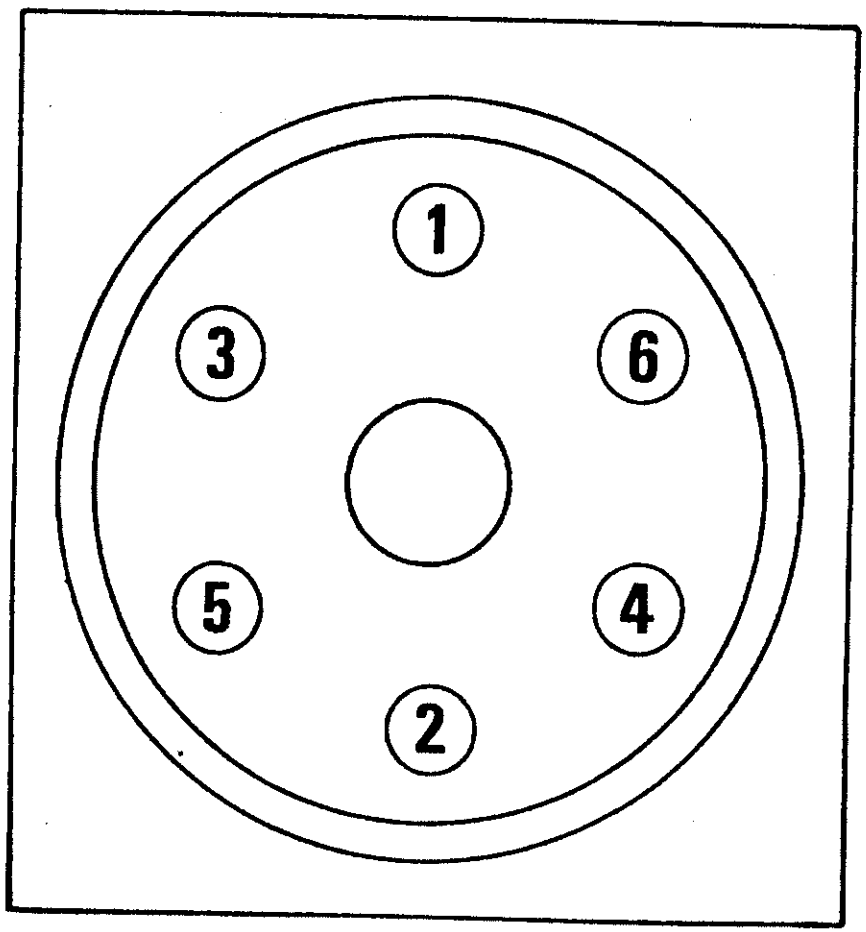


Fig. 2 Tightening Sequence for Adaptor Screws

STATIC WHEEL BALANCING

9. Thoroughly saturate the wheel with coolant oil, ensure that absolute penetration is achieved. Mount the wheel to the adaptor (remove the four balance weights from the adaptor flange) and mount the assembly to the wheelhead spindle. Rotate the wheel under power to expel the excess coolant oil.

10. Mount the wheel truer (11038 Section 'H') and true the periphery of the wheel. Remove the assembly from the machine.

11. Locate the static balancing fixture Fig. 3 on a rigid surface and adjust the knurled feet to produce the condition where the top rails of the fixture are perfectly level. Mount the wheel assembly on the balancing arbor (ref. WB.3) and place the assembly on the fixture as illustrated; the wheel will rotate and stop with the lightest point at the top. Mark this position with a pencil and secure one balance weight in the adaptor groove at this point. Once secured, this weight must not be moved.

12. Take two more weights and secure them in the adaptor groove at positions equidistant from the first weight, check that the pencil mark continues to indicate the lightest point of the wheel. Turn the assembly through 90°, hold this position momentarily and then release it. Should the pencil mark move upwards towards its original position, relocate the two outer weights closer to, but still equidistant from the first.

13. When the condition is reached where the weights are so positioned that the wheel will not rotate when positioned with the pencil mark at the top and also at 90 and 270° to this position, place the assembly to position the pencil mark at 180° to the original position. Should the wheel move from this position there is no alternative but to remove the three weights and commence to rebalance the assembly.

NOTE: The fourth weight is intended as a spare and will not be required in balancing the assembly by the above method.

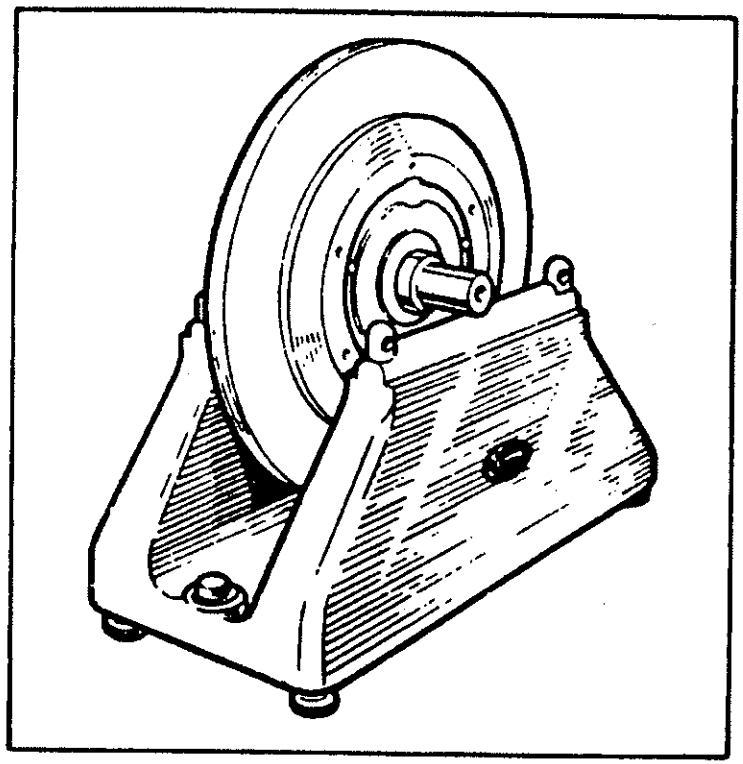


Fig. 3 Static Balancing Fixture

DYNAMIC BALANCING

INTRODUCTION

14. These instructions are applicable to Giesler type LS.264.D. portable balancing equipment manufactured by C.F.R. Giesler Ltd., River Place, Essex Road, London. N.1.

15. Balancing is effected with the wheel 'in situ' and rotating at grinding speed, thus facilitating greater accuracy and efficiency.

16. Wheel density will change as its mass decreases in usage, diamond dressing and crushing the wheel can also result in a condition of imbalance. Dynamic balancing will enable this condition to be eliminated and will also prolong spindle life by compensating for imbalance forces in a worn spindle.

17. The equipment comprises the following:-

(a) A seismic vibration pick-up unit.
(b) A power unit with control panel and variable frequency band pass filter.
(c) A stroboscope, comprising a 'Neostron' lamp, reflector and power lead.
(d) Screened cables having special non-interchangeable sockets to ensure correct conditions.

18. The equipment operates from 200-250 volts, 50 cycles single phase mains supply, but alternatives can be made available on request.

19. The frequency filter allows wheels to be balanced at speeds from 350 to 20,000 r.p.m. and imbalance is indicated on five scale ranges.

20. The seismic pick-up unit converts mechanical vibratory movement from the spindle head into electrical signals so that an exact relationship exists between mechanical input and electrical output, this is indicated on the power unit scale. The pick-up unit is sensitive to variation in spindle speed and this is nullified by passing its output through an integrating amplifier so that the dial indicator always registers imbalance displacement (amplitude) irrespective of the spindle speed.

21. A stroboscopic lamp is triggered from the same signal at the cycle peak and because the speed factor has been eliminated the lamp will flash at a frequency commensurate to the amplitude. When the lamp is held so that it flashes onto a rotating wheel, the wheel will seem to be stationary. Numbers are engraved on the periphery of the adaptor (See Para. 25) and if imbalance forces are present one

of these numbers will be consistently prominent. This number indicates the 'high spot'.

22. The 'high spot' is not necessarily the 'heavy spot' but there is a definite association between the two, the angular difference being the 'angle of lag'. The angle of lag is greater at higher wheel speeds and may read a value of 180°, the 'high spot' and the 'light spot' can therefore be coincidental.

23. The angle of lag and consequently the heavy spot are established by allowing the wheel to decelerate (switching off the drive motor).

As the wheel decelerates, adjacent numbers will progressively appear prominent and the last of these numbers i.e. the number furthest from the high spot, gives the angle of lag and is also the heavy spot. One balance weight is attached at the heavy spot and two others are equidistantly positioned relative to it such that the amplitude registered on the scale is zero or a negligible amount.

PROCEDURE - METHOD 1.

24. Thoroughly saturate the wheel with coolant. Mount the wheel to the adaptor (omit the balance weights) and mount the assembly to the machine. Rotate the wheel under power to expel the excess coolant oil. Mount the wheel truer and true the periphery of the wheel. Stop the machine.

25. The latest type of wheel adaptors are engraved with the numbers 1 to 12 as on a time clock. If an earlier adaptor is used, similarly mark its peripheral edge by engravure, chalk marks or adhesive numbers.

26. Stand the pick-up unit on the spindle head or on the crusher or dresser unit. The unit must be level and for this purpose incorporates a 'Tee' bubble and adjustable feet to compensate for the helix inclination. The unit must also be free-standing with its probe set transverse to the spindle axis.

27. Stand the power unit either on the floor or on a suitable table or trestle. Connect the three units with the cables provided and connect the mains supply. Hold the stroboscope in the hand and switch on the power unit.

28. Turn the dial indicator scale selector knob to engage the coarsest scale. i.e. (Fully anti-clockwise away from the red dot.)

29. Turn the frequency control knob in the centre of the circular scale to indicate approximately the wheel speed (r.p.m.)

30. Rotate the wheel at grinding speed.

31. Turn the dial indicator scale selector knob until a reading is registered on the scale, then tune the frequency until the dial indicator needle shows its greatest amplitude reading.

32. Hold the stroboscope adjacent to the rotating wheel (at the 6 o'clock position), and note the number which appears apparently stationary. This is the high spot. Establish the heavy spot by switching off the wheelhead motor and allowing the wheel to decelerate. Numbers adjacent to that at the high spot will appear in sequence to be stationary and the number farthest from the high spot is the heavy spot. If the number at the high spot appears to remain stationary during wheel deceleration the 'high' and 'heavy' spots are coincidental. The angle between the 'high' and 'heavy' spots is the angle of lag which remains constant at the grinding speed irrespective of wheel diameter decrement. Stop the machine.

33. Secure one weight at the heavy spot and the other two at positions equidistant to it. Start the spindle motor again and holding the stroboscope in the same position as before note the amplitude on the scale. If the amplitude has increased the two weights must be re-positioned equidistant but further from the heavy spot, if the amplitude has decreased, re-positioning the weights nearer to the heavy spot will not necessarily result in further amplitude decrement. Re-position the two weights until, with fine scale

18. When installing the piping for series 40 clarifiers or multiple units coolant flow to each must be equal. To achieve this, the junction should be as near the machine tool as possible and each pipe of as near equal length as possible.

PIPE CONNECTION - OUTLET

19. The outlet of the return pump is adjacent to the pump motor. Connection piping should be flexible 1¼" bore tubing. Ensure that there are no pipe restrictions.

LEVELLING

20. Open the lid (see para. 22) then place an engineers spirit level on top of the rotor. Insert a tommy bar through the eye-bolts at each corner of the clarifier and turn them to obtain a mean overall level. Rotate the rotor through 90° to level in both directions. Obtain a mean level when installing a Series 40 clarifier.

ELECTRICAL INSTALLATION (TYPES 201 AND 401 ELECTRICS)

21. When the clarifier is received the lids are locked.
Once the lids are locked they can only be opened again when: -

(a) Power is connected and GREEN indication lamp comes on for 30 seconds, after which the RED indication lamp comes ON. The safety lid lock device cannot be released by turning off the electrical supply.

(b) The lid lock plate is removed and the spring loaded plunger is operated by hand.

22. If electrical maintenance is necessary, the power must be left on

SINGLE ROTOR SERIES 20	TWIN ROTOR SERIES 40	MSE PART NO.	DESCRIPTION OF SYSTEM
Type 201	Type 401	23990 23993	Comprising Electrical Lid Interlock (built into Clarifier) and separate control gear in box with D.C. Injection Braking System. NOTE: As an OPTIONAL extra with the above system, an Interlocking Mains Isolator (MSE Part No. 27801) built into the control box can be supplied.
Type 202	Type 402	23991 23994	This system comprises separate control gear in control box but not Lid Interlock or Braking System.
Type 203	Type 403	23992 23995	This system comprises separate control gear in control box and rotor drive cut-off switch (built into clarifier). There is no Lid Interlock or Braking System.

NOTE: When referring to Part Nos. of electrical systems please add the appropriate suffix letter.

and the 'Stop' button pressed; the lids can then be opened. The power supply can then be turned off and normal maintenance work carried out.

23. To connect the rotor motor(s) to the electrical supply, remove the 2BA cheese headed screws located each side of the control panel compartment. Lift the entire control panel clear of its compartment (the electrical wires are long enough to allow for this). Connections to the electrical supply can now be made. These should be taken from a triple-pole, fused mains isolating wall switch using a suitable three-core heavy duty cable or three separate wires which should be threaded through the hole provided at the bottom of the control panel compartment, leaving sufficient cable to allow the panel to be withdrawn. Connect a dark green wire to the earthing terminal in the control panel and connect the other end to a suitable earthing point.

24. Connect the cable to the interlocking mains isolator (if fitted) or the 40-Amp terminal block marked LIVE MAINS located at the bottom right-hand side of the control panel (viewed from the switch gear side). The terminal block connectors are marked L1, L2 and L3 and connection to them must be so that the rotors rotate anti-clockwise when viewed from above.

25. To check rotation after connecting to the supply and with the control panel out of its compartment, trip the micro-switch located in the rectangular slot on the clarifier and press the green START button (a slight flick is sufficient). This will give an indication of the direction of rotation. If incorrect, change over any two of the three incoming supply wires.

26. Where Types 201 and 401 electrics are wall mounted, the motors and lid lock equipment must be connected to the control panel BEFORE the wires carrying the electrical supply are connected to the control panel.

27. The pumps on all clarifiers should be wired to the control panel of the machine tool and not from the clarifier control. This allows the rotor to run continually until cleaning is necessary even though the coolant flow is interrupted when changing the workpiece.

ELECTRICAL INSTALLATION (TYPES 202, 203, 402 AND 403 ELECTRICS)

28. Series 20 and Series 40 Coolant Clarifier with Types 202, 203, 402 and 403 Electrics Systems are connected to the electrical supply as follows: -

    (a) Unscrew the starter box coverlock screw and remove cover.

    (b) Pass a three-core cable and earth wire through the hole in the starter box and connect to the contactor and earth terminals.

    (c) Connect the other end of the three-core cable preferably through an isolating switch to the electrical supply. Connect earth wire to suitable earthing point.

29. Switch on the mains isolating switch (if fitted) and check that the rotor revolves anti-clockwise as viewed from above. This check is made by quickly operating the START and STOP buttons on the starter box. This is sufficient to give an indication of the direction of rotation which, if wrong, can be corrected by changing over any two wires of the incoming electrical mains supply. Replace starter box cover. On clarifiers with Type 203 and 403 electrics, depress the rotor drive cut-off microswitch located under the lid in the rectangular cut-away before operating the START and STOP button. After direction of rotor rotation has been established, release the microswitch under the lid.

FILLING WITH COOLANT

30. Remove the rubber filler cap then fill the clarifier with the correct quantity of clean coolant. When the clarifier has been filled with coolant, THE ROTOR(S) MUST ALSO BE FILLED WITH COOLANT. Never seal or obstruct the overflow duct.

OPERATING INSTRUCTIONS FOR CLARIFIERS WITH TYPE 201 and 401 ELECTRICS

31. Fit the filler cap and close the lid.

TO START PRESS GREEN BUTTON - The Red Light will go out, the lids will lock and the rotors will run at operating speed.

TO STOP PRESS RED BUTTON - The Red Light will remain out and Green Light remain on for approximately 30 seconds during which time the D.C. injection brake is operating. When the rotor stops, the Green Light will go out and the Red Light will come on. At this point the lid locks are released.

OPERATING INSTRUCTIONS FOR CLARIFIERS WITH TYPE 202, 203, 402 AND 403 ELECTRIC SYSTEMS

32. Fit the filler cap and close the lid.

TO START PRESS GREEN BUTTON - The clarifier motor will start and accelerate to its operational speed. Overload contactors in the starter box will operate if the motor is subjected to excess load.

TO STOP PRESS RED BUTTON - The clarifier motor will decelerate and stop. Do not open the lid until the rotor is stationary (approximately 5 minutes depending on weight etc.)

NOTE: Clarifiers with 203 and 403 Electrics Systems incorporate a lid operated microswitch in the contactor coil circuit. If the lid is opened whilst the rotor is at speed the contactor will drop out, thus cutting off power to the rotor.

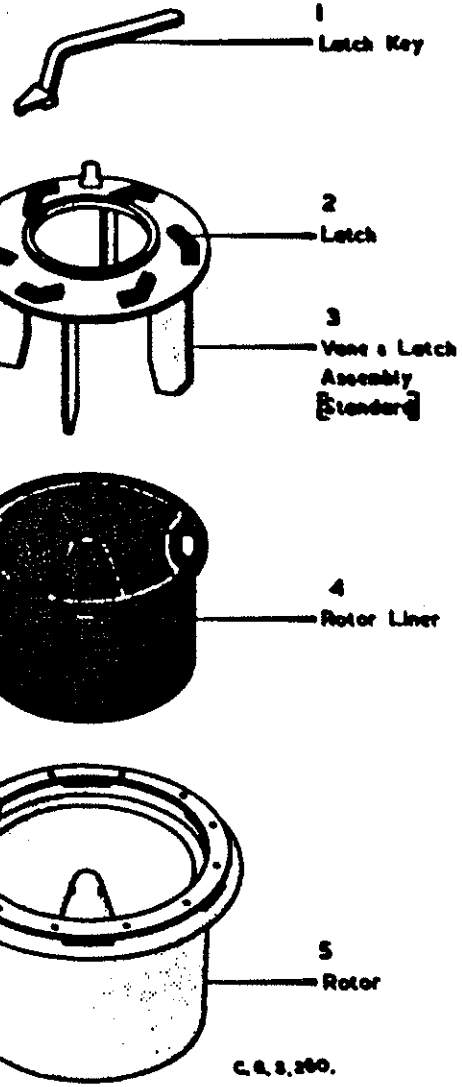


Fig. 1. Exploded View of Rotor Unit Assembly

ROTOR LINERS

33. Two types of rotor liners are used: -

(a) MSE Part No. 23884 for use with rotors on clarifiers with inlet heights of 22 inches and above.

(b) MSE Part No. 24995 for use with motorised rotors on clarifiers with inlet heights below 22 inches.

CLEANING

34. Frequency of cleaning depends on the rate of stock removal. The liners should be emptied when the spaces between the vanes are filled with solid material. Initial daily or hourly inspection will establish the cleaning.

(a) Release latches with key provided; hold the rotor with one hand (to prevent rotation) and turn the latches through 90° in an anti-clockwise direction to release.

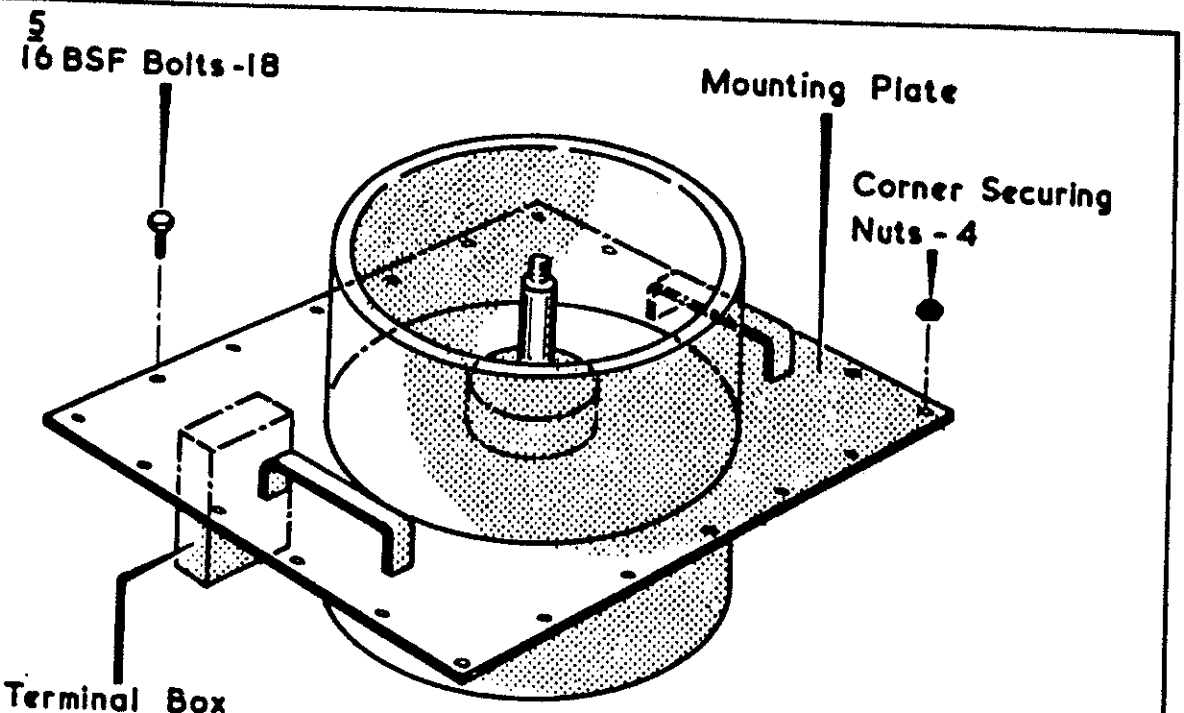


Fig. 2. Motorized Rotor Assembly

(b) Remove vane assembly by hand, or with extractor where necessary, some materials tend to stick to the vanes.

(c) Lift the filled liner from the rotor using the moulded rubber handles.

(d) Clean and replace the liner. When fitting the rubber liner, the handles must be at right angles to the vane registering tongue slot in the rotor. This allows the vane assembly to be inserted without fouling the handles of the liner.

(e) Clean and replace vane assembly. Note that the vane assembly has a registering tongue which is fitted into the slot on the rotor. This positioning is important as the complete rotor assembly has been dynamically balanced. Never fit the vane assembly from one rotor to another rotor either in the same clarifier or another clarifier because this will create imbalance. Each rotor and van assembly is stamped with corresponding identification marks to indicate correct pairing.

(f) Lock latches with the key provided.

(g) FILL LINER WITH COOLANT.

(h) Close lid, press GREEN start button.

MAINTENANCE OF ROTOR MOTORS

35. Clarifiers with 22 inch inlet heights are fitted with enclosed drip proof rotor motors fitted with grease packed bearings, which should not require attention for long periods. Grease nipple points are fitted with red caps and can be charged with Shell Alvania Grease No. 2 (or equivalent). The bearing housing on which the rotor itself runs is fitted with a special type of grease pack bearing and requires no attention. Motor protection thermal overloads will operate if the motor is overloaded.

36. To remove the rotor motor(s) proceed as follows:

(a) Remove vane assembly and liner. (Right-hand thread ½ in.dia. hole for tommy bar is provided).

(b) Remove rotor from shaft.

(c) Remove the 18 bolts and 4 nuts which secure each motor to its mounting plate.

(d) Lift out the complete motor assembly using the lifting handles on the mounting plate.

(e) Disconnect the electrical wires to the motor, either from the motor terminal box or from the terminal block in the control box. If the clarifier has 201 or 401 electrics, remove the control panel as described in para. 24.

✳ MAINTENANCE OF MOTORISED ROTORS

37. Clarifiers below 22 inch inlet have enclosed motorised rotors with 'greased for life' sealed bearings which should not require attention. Motor protection thermal overloads will operate if the motor is overloaded.

38. To remove a motorised rotor, proceed as follows:

(a) Remove vane assembly and liner.

(b) Disconnect the electrical wires to the motorised rotor from the terminal block in the control box. If the clarifier has Type 201 or 401 Electrics System, first remove the control panel as described in para. 24.

(c) Remove the bolts and nuts holding the motorised rotor mounting plate and carefully lift the motorised rotor assembly clear of its compartment by its handles. Take care not to damage the gasket under the mounting plate.

(d) Refit motorised rotor assembly in the reverse manner.

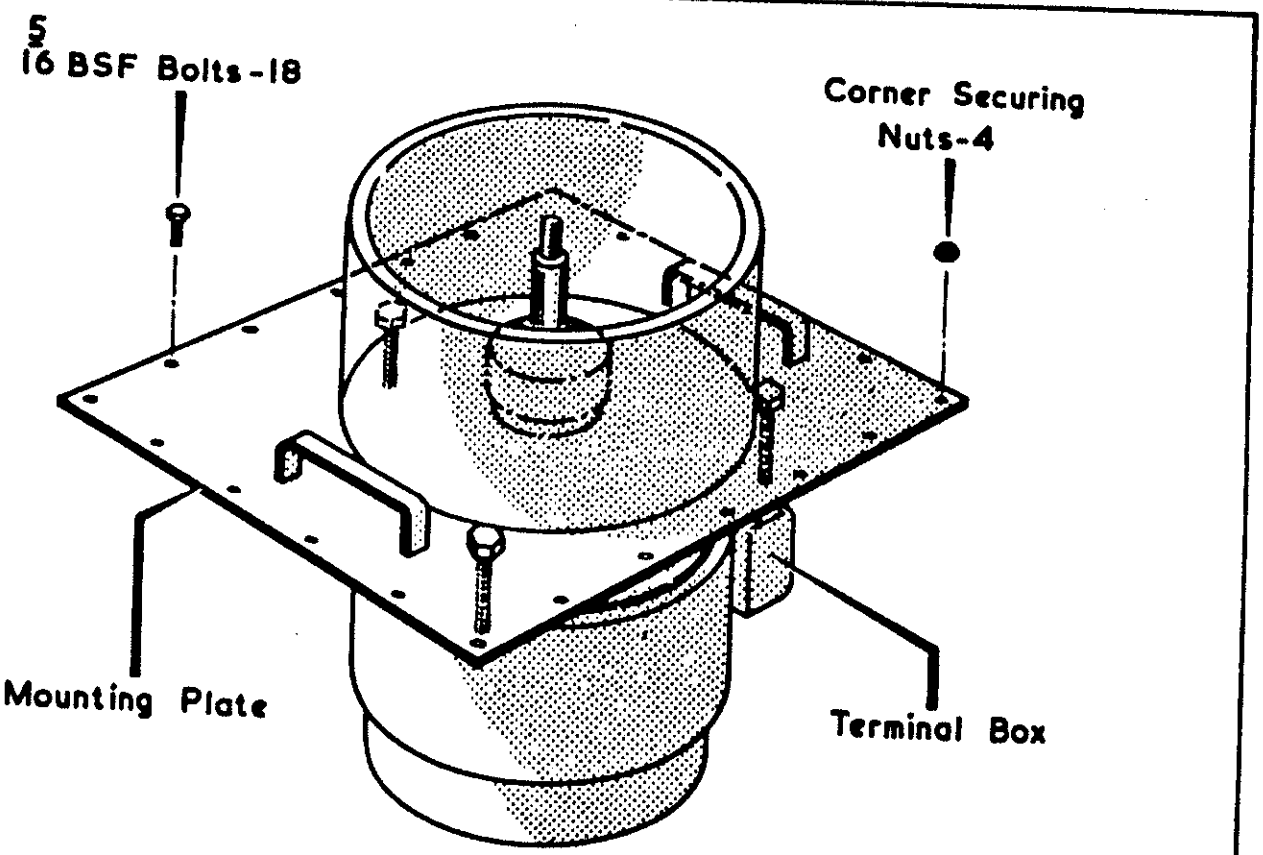


Fig. 3. Rotor Motor Assembly

NOTE: Although the majority of media will have already been centrifuged from the motorised rotor compartment, a small quantity may yet be present. Drain this by unscrewing the square plug on the under-side of the motorised rotor cradle.

ELECTRICAL SWITCHGEAR

39. Only the electrical switchgear may need occasional attention. This must be undertaken only by the works maintenance electrician.

D.C. BRAKE

40. Clarifiers fitted with Type 201 and 401 Electrics System, have a D.C. Brake. D.C. supply is provided by a full-wave bridge rectifier incorporated in the control panel. This circuit includes a time switch which is preset to supply a D.C. injection to the rotor motors for 30 seconds (50 seconds for 220 Volt Clarifier) which is normally sufficient time to stop a full rotor.

41. If more than four Start/Stop cycles are made per hour, a thermal overload may trip out. This is due to excessive heating of the motor windings caused by applications of D.C. injection voltage.

42. The brake circuit for Series 20 Coolant Clarifiers is protected by two 4-Amp fuses in the transformer primary circuit and a 10-Amp fuse in the transformer secondary circuit. Similarly, the brake circuit for Series 40 Coolant Clarifiers is protected by two 6-Amp fuses in the transformer primary circuit and a 15-Amp fuse in the transformer secondary circuit. The control circuit on all models is protected by a 2-Amp fuse.

43. Due to the high density of some materials being recovered, care must be taken to ensure that the filled liner must not exceed 50 lbs. in weight. If this weight is exceeded the factor of safety is lowered.

44. If a heavy material is being recovered, it may be necessary to increase the time of braking. This can be achieved by simply adjusting the time switch, but for all normal applications this should not be necessary.

RETURN PUMP

45. The return pump fitted to all clarifiers is capable of delivering more than the input capacity, therefore in order not to overload the rotor motor, arrangements must be made to ensure the output does not exceed the input capacity as stated on the instruction plate.

OPTIONAL EXTRAS

46. The following optional extras for Series 20 and/or Series 40 Clarifiers can be supplied in addition to the basic facilities already described.

    (a) If the user wishes to incorporate the control gear for a Series 40 Clarifier into the machine tool control panel, an Electrical Interlock (MSE Part No. 27810) for the Rotor Compartment lid can be built into the clarifier.

    (b) Vane Assembly Extractor (MSE Part No. 25288).

47. For full details of optional extras and information on adjustments not covered by these instructions please apply to Coventry Gauge & Tool Co. Ltd., quoting the correct model and serial number of the clarifier in use.

TERMINAL BLOCK INTERCONNECTIONS FOR CLARIFIERS WITH TYPE 201 OR TYPE 401 ELECTRICS ONLY

Type 201 Electrics

Interconnections between terminal blocks TB^4 and TB1 are as follows: -

TB4/1 - Red/Violet (14)			- TB1/5	
TB4/2 - Green (14)			- TB1/7	
TB4/3 - Pink (14)			- TB1/6	NOTE: TB1/10,11 & 12 not used
TB4/4 - Grey/Black (14)			- TB1/9	
TB4/5 - White/Black (14)			- TB1/4	(14) = 14/0076
TB4/6 - Red (70)	)	(	- TB1/2	(70) = 70/0076
TB4/7 - White (70)	) 3 core	(	- TB1/3	
TB4/8 - Blue (70)	)	(	- TB1/1	

Type 401 Electrics

Interconnections between terminal blocks TB^4 and TB1 are as follows: -

TB4/1 - Red/Violet (14) - TB1/5
TB4/2 - Green (14) - TB1/7
TB4/3 - Pink (14) - TB1/6
TB4/4 - Green/Black (14) - TB1/9
TB4/5 - White/Black (14) - TB1/4
TB4/6 - Red (70)) (- TB1/11

TB4/7 - White (70)) 3 Core (- TB1/12
TB4/8 - Blue (70)) (- TB1/10
TB4/9 - Red (70)) (- TB1/2
TB4/10- White (70)) 3 Core (- TB1/3
TB4/11- Blue (70)) (- TB1/1

GENERAL FAULT FINDING GUIDE FOR SERIES 20 AND SERIES 40 COOLANT CLARIFIERS

FAULT	POSSIBLE CAUSE	ACTION
Clarifier will not start	Mains supply not ON Overload out Motor Failure Contactor faulty Control coils burnt out Fuses* in clarifier control box blown Lid interlock solenoid* assembly burnt out Lid interlock microswitch* out of adjustment	Switch on mains supply Re-set overload. Fit new motor. Clean contacts. Fit new control coils. Fit new fuse(s). Fit new solenoid assembly. Adjust microswitch
Overload drop out Note: Overloads are set on manual re-set.	Coolant overflow hole blocked up Skirt full of coolant Excessive coolant flow	Clear overflow hole. Remove rotor and clean out coolant. Motor rotor assemblies have a square drain plug in the motor cradle. Reduce flow from pump.
Lid* cannot be opened	Mains Supply not on Lid interlock solenoid assembly burnt out	Switch on mains supply. When RED light comes on, lid can be opened. Fit new solenoid assembly.
Pushbuttons* do not light up	Control circuit fuse (2A) blown Lid interlock solenoid assembly burnt out Auxiliary Contacts on contactor dirty	Fit new fuse. Fit new solenoid assembly. Clean contacts.
Clarifier motor burnt out	Failure of Timer* to stop DC injection to clarifier motor when running down under brake Insulation breakdown	Fit new clarifier motor. Fit new Timer. Fit new clarifier motor.

Reduced coolant flow	Coolant pump motor running in the reverse direction	Change over any two pump motor power wires so that the pump operates in the correct direction i.e. pump shaft rotates in the direction of the arrow on the pump casting.
Excessive vibration	Occasionally, if a rotor is left standing for a long period, part of the cake may fall into the centre of the liner, thus causing an out-of-balance condition when the rotor is next used.	Remove liner and clear out cake.
	Clarifier not level	Level clarifier as detailed in the Operating Instructions.
	May be due to a latch on the rotor not completely secured	Secure latch with tool provided.
	Coolant pump out of balance	Change pump.

* Clarifiers with Type 201 or 401 Electrics System only.
** Clarifiers with Type 203 Electrics System only.

WORK CLASSIFICATION

1. Classify the work to be ground as either production work or precision (gauge) work. From this classification the method of forming the grinding wheel and the grinding method are determined.

WHEEL FORMING METHODS

2. There are two methods of forming the wheel: diamond dressing and crushing. The choice of wheel forming method is governed by the form which may be multi-ribbed, or single point. Almost any form can be produced by diamond dressing.

3. For precision work the grinding wheel must be diamond dressed.

4. For production work a crushed grinding wheel is normally employed because crushing is faster and easier than diamond dressing. A diamond dressed wheel can be employed for production work but this is not common practice except for threads having more than 40 T.P.I.

5. An extensive range of wheelforming attachments is available and these and their applications are tabulated overleaf. For grinding internal work, hobs, chasers, etc. additional attachments are necessary and their use is explained in separate sections of this manual. Refer to the 'Contents' for a complete list of all attachments.

GRINDING METHODS.

6. There are two methods of applying the grinding wheel to the work: plunge grinding and traverse (sometimes called 'pass-over') grinding. Traverse grinding is for precision work and plunge grinding which is faster but has limited applications as explained in paragraphs 9 to 12 is for production work.

7. Crushed wheels with multi-ribbed thread profiles can be used for both plunge and traverse methods but diamond dressed wheels can only be used for traverse grinding.

TRAVERSE GRINDING

8. Traverse grinding is when the rotating workpiece is traversed across the face of a grinding wheel which is inclined to the helix angle. For this method there is no infeed during traverse although repetitive passes with feed increment applied before actual grinding will probably be necessary. Figure 1A illustrates the method.

PLUNGE GRINDING

9. For plunge grinding of threaded components the grinding wheel axis is parallel to the axis of the workpiece and the machine is set so that the workpiece slowly rotates approximately 1½ turns only. On commencement of rotation of the work the grinding wheel is rapidly advanced (by use of a lever on the feed unit) so that it just touches the work, then, during the first half turn of the work, the grinding wheel is further advanced to full thread depth by turning the feed handwheel. The work continues to traverse across the face of the wheel and when it has completed a further one complete turn the wheel automatically 'rapidly' retracts from the finished work. Figure 1B illustrates the method.

10. Components can only be plunge ground if the width of the grinding

WORK	METHOD	UNIT	OPERATION	WHEEL FORM	REMARKS
External and Internal	Diamond Dressing	35L	Automatic	Multi-ribbed	Mounted on workslide
External	Diamond Dressing	LMA	Automatic	Multi-ribbed	Mounted between centres(not ideal for live centres.)
External	Diamond Dressing	VTA/1	Hand	Single point, straight sided	Mounted on wheelhead.
External	Diamond Dressing	VTR/1	Hand	Single point, profile copy	Mounted on wheelhead.
External and Internal	Diamond Dressing	11596C	Hand	Single point, profile copy	Mounted on workslide.
External	Diamond Dressing	11590	Hand	Bevel to angle of centre	Mounted between centres. For truing wheel for grinding the centre.
External and Internal	Diamond Dressing	11246	Hand	Single Point: Helicoid and straight sided	Mounted between centres. 0 - 1⅝ in. or 0 - 2½ in. or 0 - 1½ in. stroke.
External and Internal	Diamond Dressing	P234L	Hand	Single Point, Helicoid and straight sided	Mounted between centres. 0 - 3 in stroke.
External and Internal	Diamond Dressing	11038	Hand	Peripheral Truer	Mounted on tailstock barrel used prior to crushing.
External	Diamond Dressing	37LC	Automatic and Hand	Single point: profile copy Helicoid and straight sided	Mounted on wheelhead.
External	Diamond Dressing	VTG	Automatic and Hand	Single Point for Sharp Vee or Trapezoidal forms	Mounted on wheelhead.
External	Diamond Dressing	27VC	Hand	Single point: profile copy	Mounted between centres. For forming wheel for hobs. Used with Hob Grinding Attachment.
External	Crushing	160MC	Hand	Multi-ribbed	Mounted on wheelhead.
External	Crushing	160MB	Automatic and Hand	Multi-ribbed	Mounted on wheelhead.
Internal	Diamond Dressing	VTB/2	Hand	Single point: straight sided	Mounted on wheelhead.
Internal	Diamond Dressing	VTF	Hand	Single point: profile copy	Mounted on wheelhead.
Internal	Crushing	VTB/1	Hand	Multi-ribbed	Mounted on wheelhead.

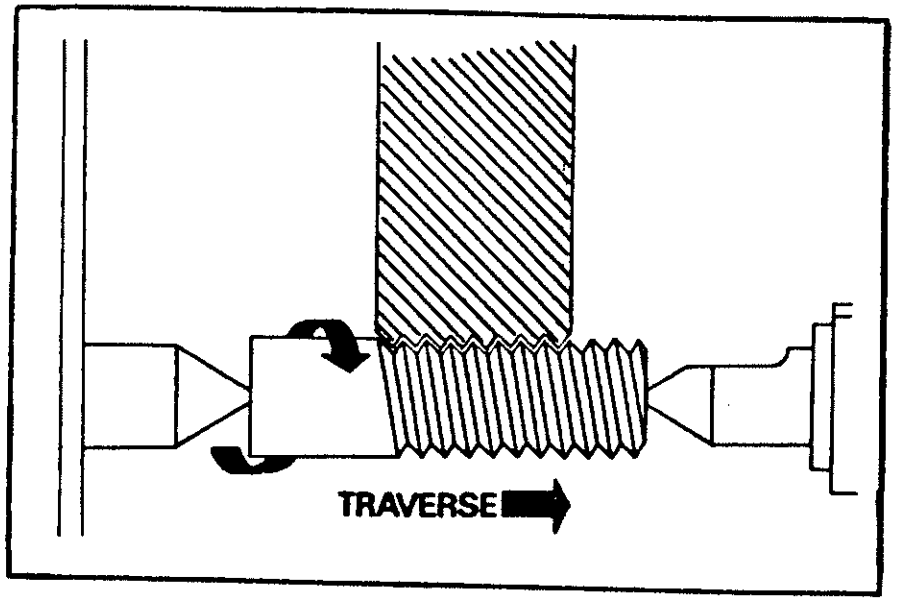


Fig. 1A Traverse (Passover) grinding method

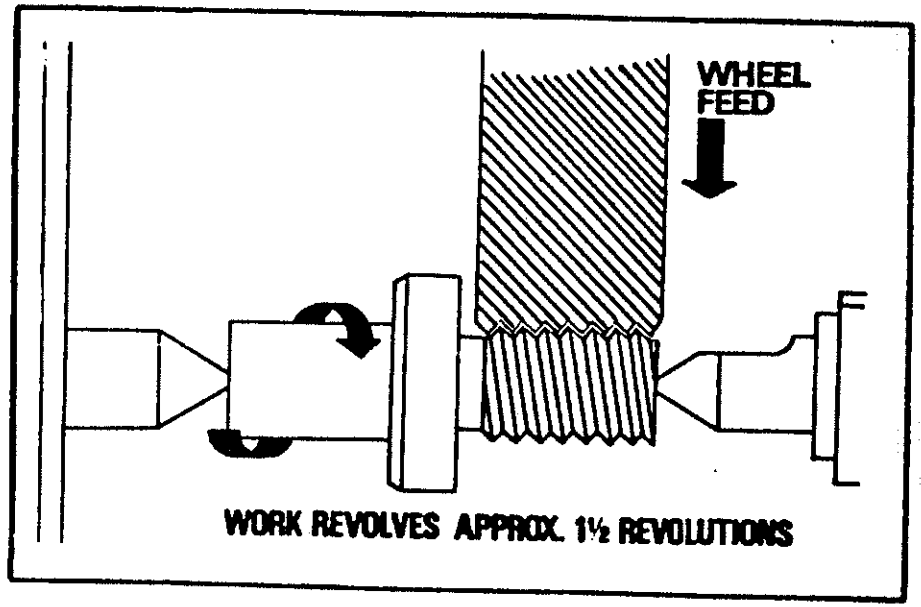


Fig. 1B Plunge Grinding Method

wheel is not less than the length of the thread. If the wheel has been formed with a 'normal pitch' crushing roller the resultant thread will be slightly inaccurate because the wheel is not inclined but such threads are usually acceptable for production work. Thread inaccuracy is proportional to the helix angle and if threads with large helix angles are to be plunge ground in large quantities the wheel should be formed with a corrected form crushing roller. Before deciding to use a corrected form roller consider the thread accuracy required, the quantity to be ground, future use, the cost and delivery time of the roller is not already in hand and the possibility of using the traverse method.

11. Plunge grinding is particularly suitable for threads close to a shoulder where an inclined wheel cannot cover the complete length i.e. would grind the shoulder. See figure 1B.

12. Annular forms are also plunge ground but the machine settings and procedure are different.

CHANGE GEARS FOR SPIRAL FLUTED WORK.

13. The instruction plate shows that the formula for gear trains for spiral fluted work is: -

$$\frac{A}{B} \times \frac{C}{D} = \frac{Lf + Lt}{Lf} \times \frac{N}{4}$$

Where Lf = Lead of flutes
Where Lt = Lead of threads
Where N = No. of flutes

The plus sign in the formula applies when the flute spiral is of opposite hand to the thread and the minus sign is applicable when flutes and threads are of the same hand.

Example:

To find suitable change gears for an ACME tap with the following particulars:

Threads per inch = 4
R.H.Threads, 3 starts
3 L.H. flutes
Lead of threads 0.75 in.
Lead of flutes = 20.343 in.

From the above formula,

$$\frac{A}{B} \times \frac{C}{D} = \frac{20.343 \text{ in.} + 0.75 \text{ in.}}{20.343 \text{ in.}} \times \frac{3}{4} = 07776508 \text{ in.}$$

Suitable change gears for this radio can easily be determined by means of the logarithms. A table of logarithms of gear ratios and the method of application may be found in "Machinery Handbook"

MULTI-START HOBS AND TAPS.

14. Let s = number of starts.
When work is indexed from start to start via the change gears it is necessary to adjust the relieving cam as follows:

$$\text{Amount of adjustment} = \frac{NLt}{SLf} \quad \text{revolutions}$$

When the hand of the flute is opposite to that of the thread the cam should be advanced. When the hand of the flute is the same as that of the thread the cam should be retarded.
When the work is indexed at the faceplate independently of the change gears, the following applies:

If N is an exact multiple of S no adjustment need be made. If $\frac{N}{S}$ gives a whole number plus a fraction, let the fractional remainder be $\frac{P}{S}$. The cam should be advanced $\frac{P}{S}$ revolutions or retarded $\frac{S - P}{S}$

Example (1) S = 8
N = 7
L = 1 R.H.
L_f = 3.5 in. R.H.
indexed via change gears cam adjustment $\frac{7}{28} = \frac{1}{4}$ revs.

The hand of thread is opposite to that of flute therefore the cam shall be advanced.

Example (2) as above indexed via faceplate.

$\frac{N}{S} = \frac{7}{8}$ therefore cam should be advanced $\frac{7}{8}$ revolutions or retarded $\frac{8 - 7}{8} = \frac{1}{8}$ revolutions.

SETTING THE RELIEF

15. It is important that the relief is set in correct relationship to the flute. Using a clock indicator, take a reading on the wheelhead, revolve the workhead, and stop the machine when the cam is at the peak of its throw. Place the work in the centres, and with the driver contacting the work carrier, rotate the faceplate until the wheel is just leaving the back edge of the land for right hand taps, or just entering the back edge of the land for left hand taps (figure 2). After setting, the faceplate can be locked up and need not be disturbed again.

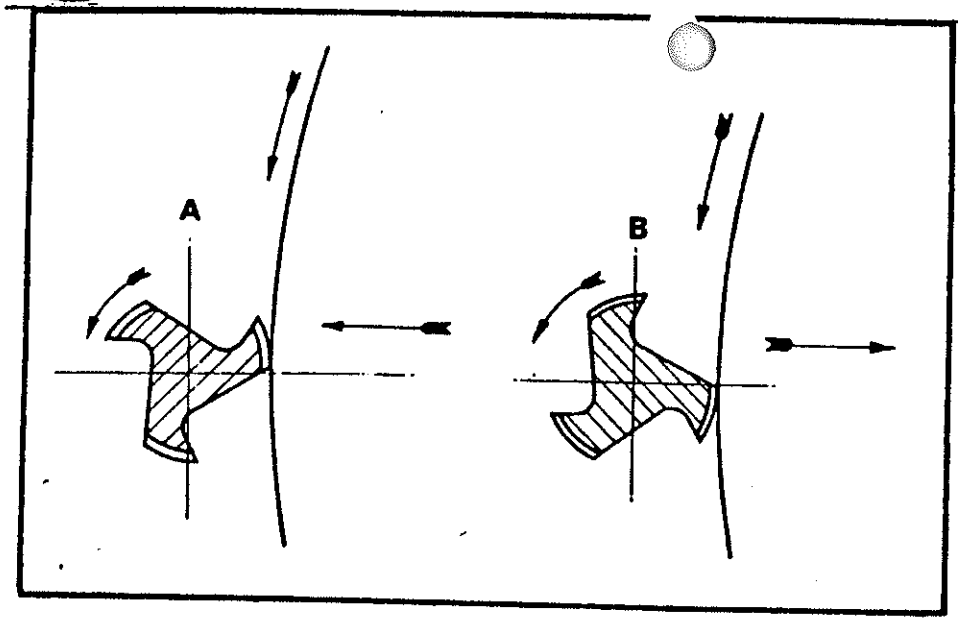


Fig. 2 Tap setting for R.H. and L.H. relief

GRINDING THE TAP

16. The method of operating is the same as for production work except that when plunge cutting, taps of small section may spring off the wheel; if this is enough to exceed the limits of the tap proceed as follows: Feed the wheel into depth less 0.0005 in. to 0.001 in. (.01270 mm to .0254 mm) of finished size, revolve the faceplate once, and add the extra cut to finish the tap to size, making a total of exactly two work revolutions. The wheel should start and finish in a flute. It is essential that during plunge cut operations, especially on high steel taps, the maximum amount of coolant should be forced into the wheel.

17. Multi-Start Hobs and other coarse lead work will require the use of a single-rib wheel. Thread Milling Hobs with annular threads or with spiral flutes, should also be ground with a single-rib wheel. A Hob having fine threads and small spiral angle flutes, may be ground with a wheel having a few ribs, the resultant error being very small. The correct spacing of the starts is effected by means of the back index rings, or the front faceplate of the workhead. See the section of "Workhead" for operational instructions.

18. When indexing from start to start on a multi-start hob or tap, it is sometimes necessary to alter the position of the relieving cam. The procedure is the same for both straight and spiral flutes. It is not necessary to alter the position of the cam when either the number of starts are the same as the number of flutes, or divide evenly into the number of flutes.

19. The amount it is necessary to move the cam, in degrees is given by:

$$E = F\left(\frac{360}{N} - \frac{360}{F}\right)$$

Where "F" is the number of flutes, "N" is the number of starts and "E" the number of degrees to be moved. In most cases it will be found that the number of degrees it is necessary to move the cam, can be expressed as a whole number of teeth of gear "D" on the cam shaft. For example, a hob having 4 starts and 7 flutes will require to have the cam advanced 45 teeth of the 60 tooth gear, i.e. gear "D" when indexing from one start to another by means of the back index ring. The cam will always be advanced when the number of flutes exceeds the number of starts.

NOTE: Should it be necessary when advancing gear "D" to remove gear "B", care should be taken to ensure that the gear "B" meshes with gear "A" in the same position as before.

20. When it is not possible to effect the correct advance to the cam by means of the teeth in gear "D" it may be possible to do so by moving gear "B". For example, consider a hob having 9 starts and 10 flutes. The formula gives 40° as the advance to the cam, but it is impossible to effect this with a 60 tooth gear.

The formula: $\frac{B \times E^{\circ}}{360} \times \frac{D}{C}$

gives the number of teeth gear "B" must be rotated relative to gear "A", to produce an advance of E° on the cam. "B", "D" and "C" represent the number of teeth in these gears. Continuing the above example, and substituting values in the formula we have:

$$\frac{48 \times 40^{\circ}}{360} \times \frac{60}{80}$$

which gives 4 teeth as the number "B" must be moved to effect 40° advance on the cam.

21. When grinding an annular Threaded Hob, having spiral flutes, with a single ribbed wheel, it is necessary to adjust the position of the relief when spacing out. This adjustment is obtained by rotating the faceplate an appropriate amount, to cause the relief to be either advanced or retarded, as required. The amount per thread pitch, in minutes, is

$$\frac{21,6000}{\text{Lead of Flute} \times \text{T.P.I.}}$$

OPERATING INSTRUCTIONS

22. This section details the setting and operational sequence for the production of a right hand threaded, fluted and relieved component. Alternative sequences for internal threads, spiral fluted work, and hobs, can be ascertained by reading additionally the notes detailed under those headings:

23. Select the wheel, (refer to the section 'Grinding Wheels') and thoroughly soak it in coolant.

24. Release the two knurled screws and open the wheel guard.

25. Remove the large nut securing the grinding wheel. Note that this nut has a left hand thread. Detach the wheel with the aid of the extractor.

26. Fit the new wheel to the arbor and mount it on the machine.

27. Turn the wheelhead switch to 'High Grind' and press the Master Start button to spin the wheel and throw off excess oil. Stop the wheel.

28. Fit the Wheel Truer to the tailstock and true the wheel. Refer to 'Wheel Truer'.

NOTE: An alternative method to that detailed in 'Wheel Truer', of traversing the truing diamond, is to remove the driven gear from the pitch change gear train at the top of the workhead, and use the handle supplied, on the shaft, to traverse the complete table.

29. Balance the grinding wheel by one of the methods detailed in 'Grinding Wheels'.

30. Re-fit the wheel to the machine and repeat the truing operation.

31. Mount the No. 16 G.M.C. Crusher on the machine, and crush the wheel as detailed in 'Multi-rib Wheel Crusher'.

32. Incline the wheelhead to the appropriate helix angle (refer to Wheelhead and Wheelhead Feed).

33. Select and fit workhead speed pick off gears after reference to the chart on the inside of the gearbox door.

34. Select and fit pitch change gears at the top of the workhead according to the pitch required. An instruction plate inside the hinged cover details the selections.

35. Select 'High Ratio' as applicable on the lever at the front of the workhead.

36. Select the adjacent lever to 'High' or 'Low' range as required.

37. Unlock the lever at the R.H. end of the machine and set the required taper in accordance with the information on the adjacent data plate.

38. Select and fit the necessary flute change gears according to the information on the data plate inside the gearbox door.

39. Check that the relief cam is fitted in the correct attitude i.e. with the face marked R.H., facing outwards. (For left hand threads and the face marked L.H. would face outwards).

40. Set the amount of relief i.e. depth of relief, required, in the following manner. Loosen the large locknut at the bottom of the link lever and turn the Relief Adjustment Knob until scale shows the required reading. The datum line for the scale reading is the vertical surface of the rear of the locknut. After adjustment, tighten the locknut. Note that if no relief is required the flute change gears must be removed and the Relief Adjustment Knob turned until the follower is clear of the cam.

41. Loosen the lockscrew on the front of the 'Amount of Land Control' and adjust the control knob to suit the required land. One complete turn of the knob gives an amount of unrelieved land equal to 1/8th of the total width of one land: As an example, if each land is required to be concentric for half its width and relieved for the other half, the knob would be given four complete turns. Tighten the lockscrew after adjustment.

42. Mount the tap between centres and set the relief. Refer to 'Setting Instructions and Calculations for Fluted Work'.

43. Set the two Traverse Control Stops on the front of the machine to allow traverse to the end of the proposed thread on the work, plus approximately three threads at one end, and just clear of the threads at the end where 'throwout' takes place.

44. Set the throw-out trip so that it operates the plunger just before the adjacent Traverse Control Stop is contacted. Note for a R.H. thread this is the left hand stop and vice versa.

45. Turn the 'Workhead' switch to 'R.H.'.

46. Turn the Wheelhead switch to 'Low Grind' and press the Master Start button to start the wheel.

47. Ensure that the wheel is well clear of the workpiece, and raise the Wheelhead Return Lever to advance the wheelhead. The wheel must still be clear of the workpiece at this stage.

48. Operate the Traverse Control Lever to start the workhead. Turn the wheelhead handwheel until the wheel lightly contacts the workpiece. If for any reason a pre-roughed workpiece is being ground, operate the handwheel and side-cut control simultaneously until the wheel lightly but equally contacts both flanks of the pre-roughed form.

49. From the above condition, i.e. with the wheel lightly contacting the workpiece (plain or pre-roughed) depress the Rapid Throw-out Lever to retract the wheel from the work. Traverse the workhead back to the starting point by means of the 'Traverse' Control Lever.

50. Loosen the two knurled nuts at the front of the Wheelhead Handwheel and turn the scale until the required amount of feed is indicated against the zero mark. Tighten the knurled screws.

51. Press the Master Stop button. Select 'Grind High'.

OPERATING SEQUENCE

52. Press the Master Start button to start the wheel.

53. Set the Coolant Supply switch to 'Intermittent'.

54. Operate the Traverse Control Lever to the left to traverse in the forward direction.

55. Pull up the wheelhead return lever, and wind in the feed hand-wheel with an even motion until contact with the stop is made. Do not feed too slowly. It is essential that the work revolves at least one complete revolution after the wheel has been fed to depth and before the throw-out trip is automatically actuated.
NOTE: The foregoing instructions are specifically for plunge cutting. When pass-over grinding, the wheel is fed in to depth before traverse is engaged.

56. Operate the Traverse Control Lever to the right.

57. Press the Master Stop button.

OPERATING INSTRUCTIONS

AN EXAMPLE OF PLAIN TRAVERSE GRINDING FROM A SOLID BLANK

58. Any one of the following wheel forming units can be used.

(a) 35L Diamond Dresser for Multi-ribbed wheels together with a suitable cam and diamonds. Refer to the appropriate section C.

(b) LNA Diamond Dresser for Multi-ribbed wheels together with a suitable cam and diamonds. Refer to the appropriate Section C.

(c) 16 GMB Automatic Crusher for Multi-ribbed wheels together with a suitable crushing roller. Refer to the appropriate Section F.

(d) 16 GMC Manual Crusher for Multi-ribbed wheels together with a suitable crushing roller. Refer to the appropriate Section F.

59. Work holding equipment can comprise either of the following.

(i) Two centres and a work carrier or

(ii) One collet and one tailstock centre.

60. For precision work, a diamond dressed wheel is recommended and the work should be mounted between centres. A crushed wheel is suitable for production work and the work can be mounted in a collet and centre.

GRINDING METHOD.

61. Traverse grinding must be employed.

PROCEDURE

62. Select, mount, true and balance a 25 mm (1 in.) wide grinding wheel as instructed in Sections G.

63. Set the coolant cock to half open, turn the 'Coolant' switch to 'Continuous' and set all other switches to 'Off'. Press the 'Master Start' button and turn the grinding wheel by hand until it is soaked in coolant. Press the 'Master Stop' button and close the coolant cock. Turn the 'Coolant' switch to 'Off' and the 'Wheelhead' switch to 'High Grind', press the 'Master Start' button and then, when the oil has been centrifugally expelled from the wheel, press the 'Master Stop' button.

64. Set the grinding wheel to the helix angle. Refer to Section Z.

65. Set the 'Wheelhead' switch as follows.

(a) to 'Low Grind' if the wheel is to be dressed using the 35L or the LNA unit,

(b) to 'Auto Crushing' if the 16 GMB crusher is to be used and operated automatically, or

engaged, negligible amplitude is indicated.

34. The wheel is 'in balance' when the stroboscope can be held at any circumfrential position and no number is seen to be predominant.

NOTE: When the majority of imbalance forces have been eliminated, re-truing the wheel will usually result in a more accurate final balance condition.

PROCEDURE - METHOD 2

35. Mount the wheel on its adaptor and create a deliberate heavy spot by securing all three weights together at any point on the adaptor. Note the number adjacent to the centre weight. Mount and secure the assembly to the spindle nose but do not fit the wheel guard(s).

36. Proceed as detailed in paragraphs 24 to 31.

37. Scan the numbers with the stroboscope until, at one position, the number adjacent to the centre weight appears to be stationary. Note the amplitude indicated on the scale. Stop the machine.

38. Re-position the two outer weights further, but equidistant from the centre weight and again rotate the wheel at grinding speed. Hold the stroboscope in the same position as before and again note which number appears to be stationary.

39. If the same number (i.e. the number adjacent to the centre weight) is again prominent then this continues to be the heavy spot and the two outer weights must be moved yet further from it.

40. If another number appears to remain stationary, then the imbalance is near this number and the nearer of the two balance weights (not the one adjacent to the original heavy spot) must be re-positioned. This weight must be moved further from the original heavy spot if the amplitude has increased, but movement of the weight towards the original heavy spot will not necessarily decrease amplitude.

41. Re-position the weights until, with fine scale engaged, nil or negligible amplitude is indicated.

42. When the wheel is 'in balance', the stroboscope can be held in any circumfrential position and no number will be predominant.

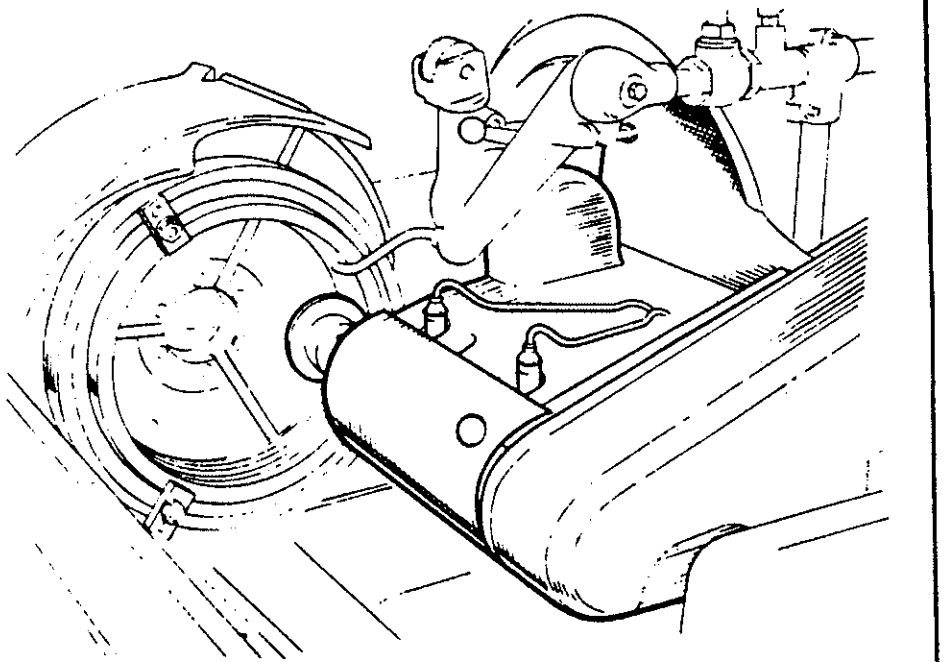


Fig. 1 Internal Grinding Attachment

37M INTERNAL GRINDING ATTACHMENT.

INTRODUCTION

1. The internal grinding attachment (Fig. 1) is a self-contained unit for mounting to the wheelhead drum and will permit internal thread grinding on components from ¾ in. (19 mm) bore upwards to the capacity of the machine. A rigid one piece casting houses the spindle drive unit and interchangeable wheel spindles, provision is also made on the attachment for mounting the internal wheel diamond dressing or crushing unit.

ATTACHMENT MOUNTING

2. To change from external to internal grinding operations; remove the belt cover together with the drive belts and motor pulley. Remove the rear guard plate. Disconnect the flexible lubrication pipes at the wheelhead unions; remove the top cover and side guards from the wheel. Remove any attachment mounted on the external spindle attachment face. Arrange suitable lifting tackle, release the spindle unit securing nuts and remove the spindle unit from the wheelhead drum.

3. Thoroughly clean the internal attachment and wheelhead drum abutment faces, locate the attachment on the wheelhead tenon and secure the retaining bolts. Assemble the pulley guard backplate and mount the required motor pulley.

4. Connect the two flexible lubrication pipes to the spindle housing, the feed pipe being attached to the distributor block and the drain pipe to the forward connection.

the holes in the transmission ring. Replace the end cap and retaining screws.

HANDWHEEL STOP RING

9. In order that this feature may be utilised for internal grinding operations it will be necessary to transpose the sliding catch after first removing the manual feed handwheel.

WHEEL MOUNTING

10. Fig. 2 illustrates the method by which small diameter wheels are mounted directly to the spindle. Wheels should be mounted between fibre washers, ensure that these are in good condition. The bore of the wheel should be a good fit on the centre screw.

11. The adaptor assembly utilised with medium capacity spindles is illustrated in Fig. 3, packing washers will not be required between the wheel and adaptor flanges. Ensure that the wheel is a good fit on the adaptor flange. Two 'C' spanners will be required to mount the assembly, one located on the adaptor and the other employed to secure the locknut. Removing the adaptor assembly from the spindle is effected by unscrewing the right hand threaded screw (3) against the centre collar, prevent the spindle from rotating by fitting a spanner on the two spindle flats.

12. The method of mounting the larger capacity wheels is illustrated in Fig. 4. To remove the wheel and adaptor unit remove the locknut (2) (holding the spindle with a 'C' spanner on the adaptor). Mount the special extractor Fig. 5, tightening the centre screw to withdraw the assembly from the spindle nose.

IMPORTANT: Spindle and drive unit assemblies are assembled and tested under controlled conditions. It is therefore recommended that should the necessity for adjustment or dismantling arise the complete unit should be returned to the manufacturer for rectification and re-build.

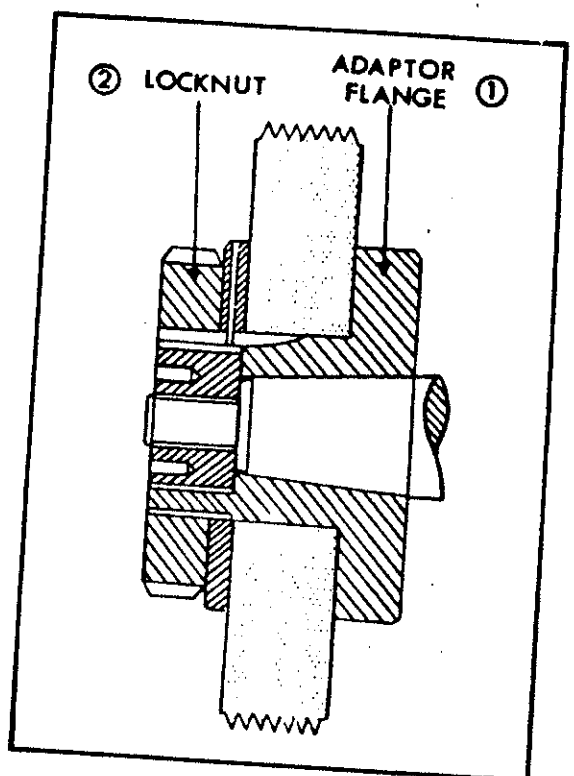


Fig. 4 Large spindle adaptor mounting

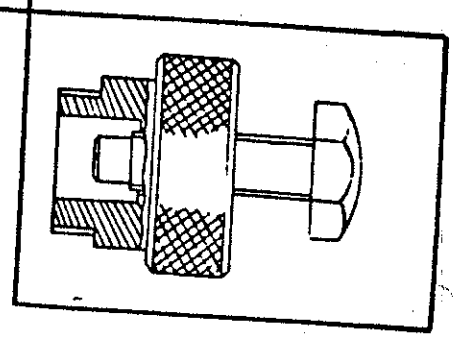


Fig. 5 Adaptor extractor

5. The internal coolant supply should now be fitted as follows:-

Remove the rear cover plate from the workhead. Insert the coolant supply tube into the hollow collet drawbar spindle and secure, utilising the special spanner provided.

NOTE: Certain machines will require the collet drawbar handwheel and end cap to be removed.

6. Fit the bracket over the cover opening at the rear of the workhead and connect the flexible coolant supply hose to the coolant pump tee connection. A short length of formed tube with an adaptor is fitted to the main coolant pipe, replacing the nozzle used for external operations. The internal coolant supply tube may be extended through the workhead and the nozzle adjusted as required; when fully extended the tube is retained by a sleeve nut. A hinged splash guard to enclose the chuck or faceplate can be mounted to the tenon at the rear of the workhead casting.

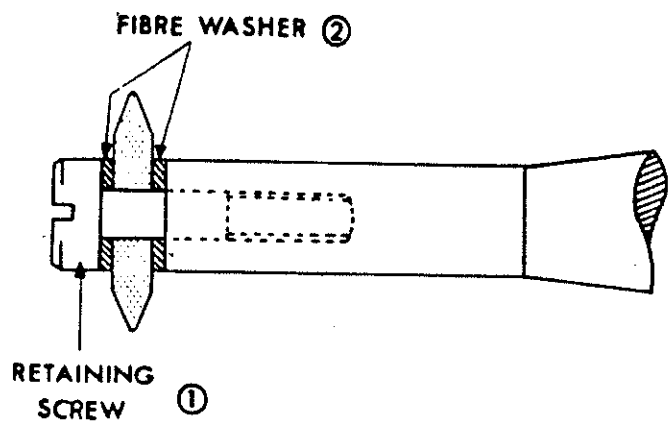


Fig. 2 Wheel mounted directly to spindle

INTERNAL SPINDLES.

7. Spindle drive is effected by a common drive unit housed in the attachment body, the drive being transmitted to the spindle by a leather transmission washer. The standard spindle unit supplied with the attachment is suitable for all internal grinding operations where the bore of the component is between 1½in. (38 mm) and 5 in. (125 mm). In addition a complete range of alternative spindles, fully interchangeable in the attachment housing are available for components having bore diameters from ¾ in. (19 mm) up to the maximum capacity of the machine.

SPINDLE MOUNTING

8. Ensure that the leather transmission ring is fitted and is in good condition. Remove the spindle retaining ring from the housing and insert the spindle unit, the location dowel engaging the slot in the housing. Rotate the drive pulley and spindle to ensure that the drive pins correctly locate

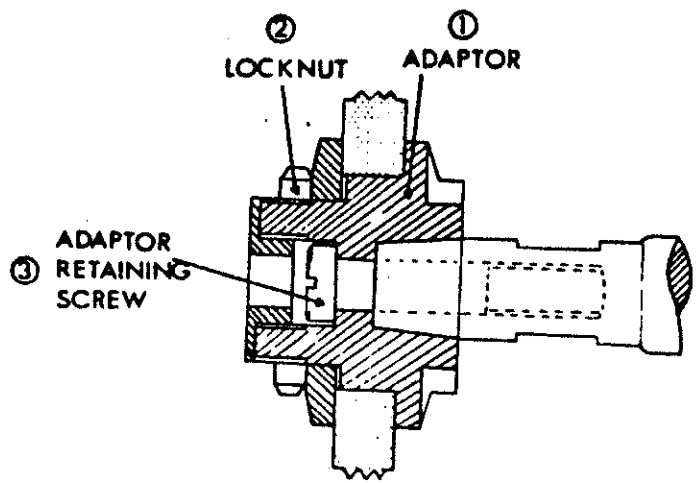


Fig. 3 Medium spindle adaptor mounting

37M. GRATICULE MICROSCOPE

INTRODUCTION

18. The graticule microscope and ancillary lighting attachment facilitates accurate checks to be made of the wheel and component thread form without the necessity of removing either from the machine. Microscope and accompanying lighting attachment are readily mounted to the machine, the former being simply retained by a cast bracket which slots on to the front of the tableguard; the lighting fitting is located on a special lug provided on the wheelhead, electrical connection being made to a pre-wired socket on the electrical cabinet.

MICROSCOPE GRATICULES

19. The graticule is an optically correct glass engraved with a facimile of the thread form; each is supplied in a special mount from which it must not be removed. Graticules are readily interchangeable in the mounting holder and a wide range are available in addition to the standard which shows thread angles of $47\frac{1}{2}^{\circ}$ - 55° and 60°. Alternative graticules are as follows, a separate graticule embraces each of the following thread ranges:

B.S.W. Forms.

(a) 4 - 4½, 5, 6, and 7 T.P.I.
(b) 8, 9, 10 and 11 T.P.I.
(c) 12, 14, 16 and 18 T.P.I.
(d) 20, 22, 24, 26, 28, 32, 40, 48 and 60 T.P.I.

Metric Pitches.

(a) .25, .3, .35, .4, .45, .5, .6, .7, .75, .8, .9, 1.0, 1.25, 1.5, and 1.75 mm.
(b) 2.0, 2.5, 3.0, 3.5 and 4.0 mm.

Graticules for thread forms other than those listed above can be made available on receipt of the relevant form details.

ASSEMBLY

20. Mount the lighting fitting to the wheelhead lug and connect the supply cable to the socket provided on the electrical cabinet. Locate the microscope support bracket on the machine front guard and secure the knurled retaining screw. Release the graticule holder retaining screw and position the graticule and holder in the prisom stem. Fit the eyepiece to the dovetail mount on the stem head and secure the assembly by means of the ballend retaining lever.

21. Remove the objective lens from its protective case and screw it into the prisom stem. Adjust the assembly to focus and align the graticule form to the actual wheel form.

IMPORTANT: The graticule microscope is a precision instrument and the utmost care should be exercised in handling it. Always ensure that the objective lens and graticules are returned to the special protective cases after use. Photographic lens tissues should be used for cleaning purposes.

40P WORK LOCATOR

INTRODUCTION

22. The 40P work locator Fig. 7 is a valuable asset for production grinding of pre-roughed workpieces and enables each component in the batch to be pre-set for loading in the machine in the correct relationship to the wheel ribs; obviating re-setting the machine controls for each component.

23. The locator comprises a base bar supporting two cast brackets and a centre stylus bracket. The fixed end bracket incorporates a

MOUNTING THE WORKPIECE

13. It is recommended that ring gauges and similar components should be mounted utilising a faceplate fitted with the special 'MATRIX' block clamps Fig. 6. When mounting the component ensure that sufficient space is allowed at the rear of the component to permit the wheel to pass completely through the component bore.

14. Two optional faceplates are available, these being 6 in. (152 mm) and 12 in. (305 mm) in diameter. Both faceplates are supplied complete with block clamps, teebolts and support screws (Fig.6).

15. For production work a 9 in. (228 mm) capacity 3-jaw chuck is available as an alternative method of workholding.

SPINDLE SPEED CONTROL

16. The 'wheelhead' switch is provided with an 'internal grinding' position which must be selected prior to the 'start' button being pressed. When grinding, the internal spindle rotates in the opposite direction to the external spindle, the exception being the dressing operation. Switch selection when changing from internal grinding to diamond dressing is as follows:
    (a) Depress the 'stop' button.
    (b) Select 'External grind' and position the wheelhead switch at 'high grind'.
    (c) Press the 'start' button.
    (d) Select 'low grind'. An interval of a second or so should elapse between (c) and (d).

17. Internal grinding to crushing the wheel necessitates the following selection sequence:

    (a) Depress the 'stop' button.

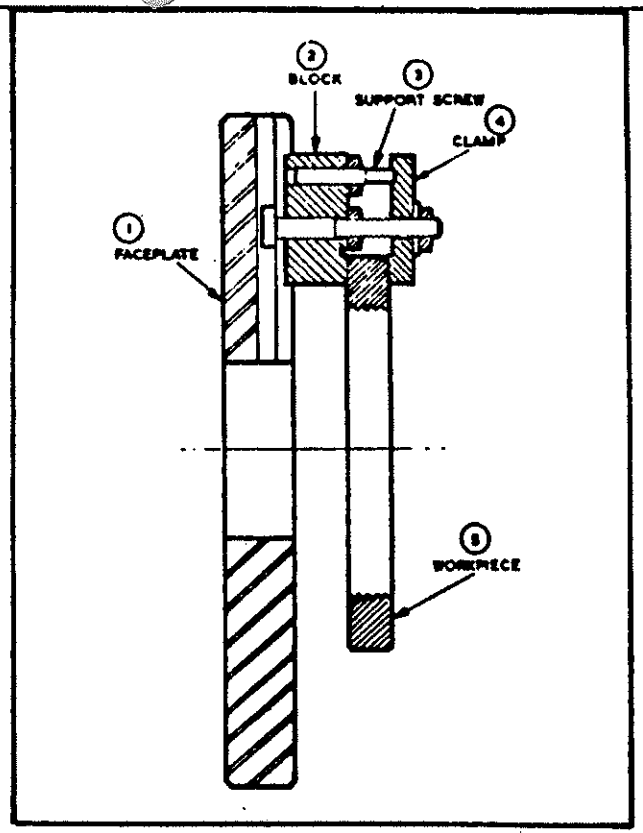


Fig. 6 'Matrix' block clamps

    (b) Select 'external grind'.
    (c) Select 'high grind'.
    (d) Press the 'start' button.
    (e) Select 'off' on the wheelhead switch.
    (f) Select 'crushing' on the wheelhead switch.

NOTE: 'Continuous' coolant should be selected and applied during both operations.
With the 12 in. diameter faceplate mounted it will not be possible to form the wheel with the 35L Multi-Ribbed Diamond Dresser.

centre to which an adjustable arm fitted with a dummy driving peg is attached to simulate the workhead faceplate. The adjustable end bracket is fitted with a spring loaded centre to simulate the tailstock. A suitable stylus (selected from the range available for a wide range of pitches) is held in a spring loaded plunger in the stylus bracket, simulating the wheel ribs. A dial indicator is fitted to register the stylus contact with the workpiece.

SETTING

24. The first finish ground component complete with the work carrier is mounted between the locator centres, the plain prong of the carrier fork locating the dummy driving peg. Lock the carrier to the peg with the knurled screw in the opposite prong. Lock the sliding end bracket to the base bar; mount the dial indicator and a suitable stylus.

25. Position the stylus bracket approximately central along the form axis; pivot the bracket so that the stylus makes contact with the root form and a reading is obtained on the dial indicator. Lock the stylus bracket to the base bar.

26. Slacken the adjustable arm lockscrew and slowly rotate and counter-rotate the workpiece, carrier and adjustable arm as one unit until the reversal point of the indicator needle is ascertained; tighten the adjustable arm lockscrew. The stylus will now be in the position occupied by the grinding wheel on its final pass and equidistant from both flanks.

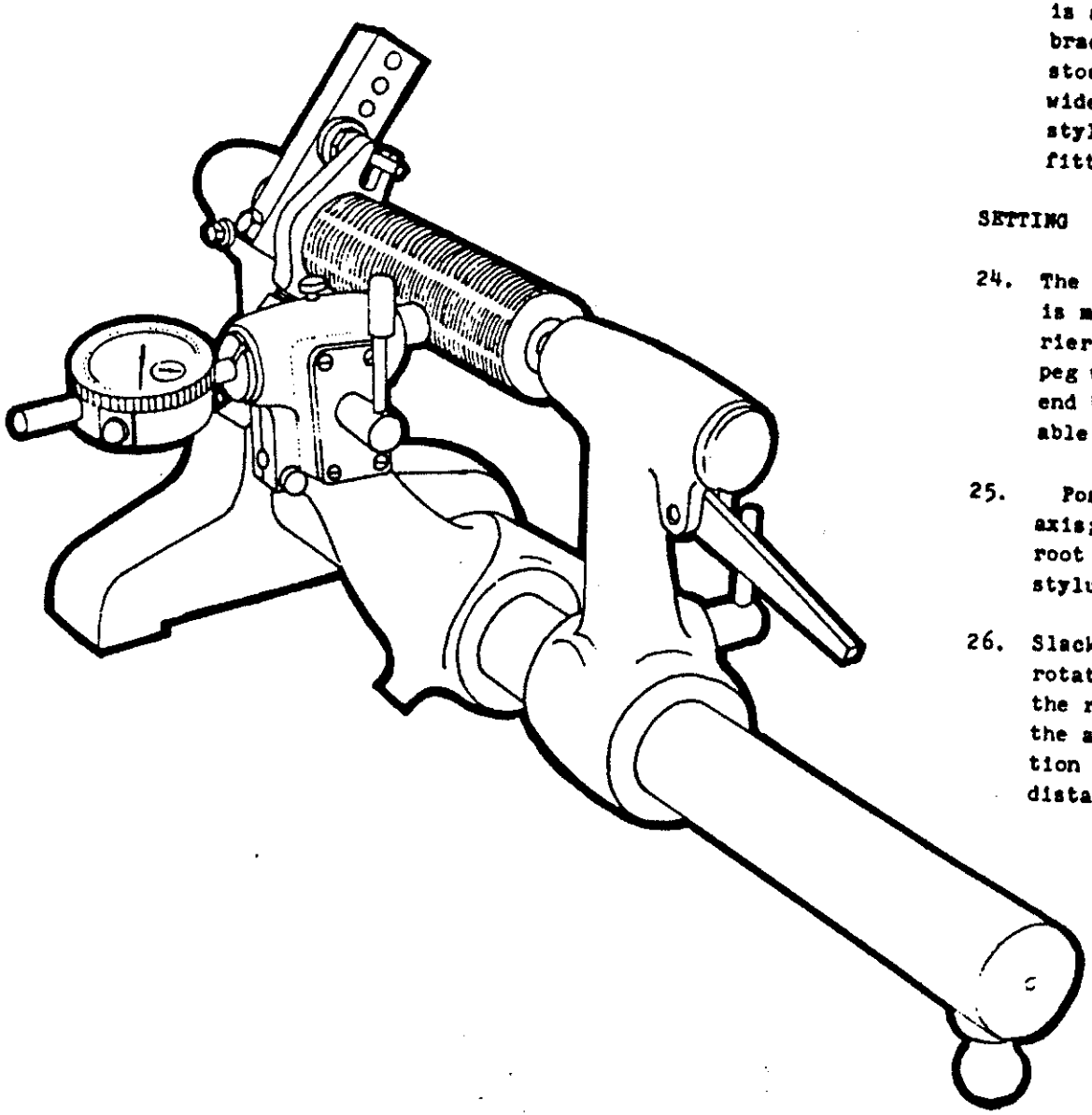


Fig. 7 40P Work Locator

81. Close the coolant cock.

82. Press the 'Master Start' button.

83. Move the traverse control lever to the right. The work will traverse to the left. When the mid position is reached (approximate) return the lever to the vertical position.

84. Slacken the feed stop locking screw and push the feed stop backward. Turn the feed handwheel until the wheel just touches the work and then press the rapid throw-out lever on the right hand side of the feed unit.

85. Move the traverse control lever to the right. The work will traverse to the left and stop at the traverse extremity.

86. Loosen the two knurled nuts on the front of the feed handwheel. Move the feed stop forward and turn the knurled stop ring so that its integral stop contacts the left hand edge of the feed stop.

87. Turn the feed handwheel to advance the grinding wheel the thread depth distance, lock the feed stop and tighten the two nuts on the handwheel.

88. Raise the rapid infeed lever on the left hand side of the feed unit.

89. Open the coolant cock.

90. Position the splash guard.

91. Move the traverse control lever to the left. The work will traverse across the face of the grinding wheel and will stop when the full thread length has been ground and the wheel will then automatically retract rapidly. Movement of the traverse control lever to the right will return the workslide and the machine will stop in the correct position for grinding another identical component.

NOTE: If the machine has an 'Auto Return' switch the workslide will automatically return to the correct position for grinding another identical component.

OPERATING INSTRUCTIONS

AN EXAMPLE OF PLUNGE GRINDING FROM A SOLID BLANK

EQUIPMENT

92. Either of the following crushers can be used to from the wheel.

(a) 16 GMB. Automatic crusher for multi-ribbed wheels together with a suitable crushing roller. Refer to the appropriate Section F.

(b) 16 GMC. Manual crusher for multi-ribbed wheels together with a suitable crushing roller. Refer to the appropriate Section F.

93. A diamond dressed wheel can be used but a crushed wheel is more able to withstand the pressure on it during plunge grinding.

94. Work holding equipment can comprise any of the following.

(i) Two centres and a work carrier,

(ii) A 230 mm (9 in.) three jaw chuck, or

(iii) One collet and one workhead centre.

The choice will depend on the work and the equipment available.

GRINDING METHOD

95. Plunge grinding must be employed because the shoulder prevents the full thread length being traversed across the face of the wheel.

113. Remove the finally driven pitch change gear from top of the workhead and engage and turn the pitching handle until the left hand edge of the grinding wheel is aligned with the left hand extremity of the required thread length position on the work. Turn the feed handwheel until the wheel almost touches the work and, if necessary, turn the pitching handle to finally align the work to the wheel.

114. Press the master 'Stop' button to ensure that all the motors have stopped and set the control station switches as follows.

Wheelhead	High Grind
Workhead	R.H.
External/Internal	External - On
Coolant	Off
Hob Grinding	Off

The settings of the other two switches are immaterial at this stage.

115. Remove the pitching handle and replace the pitch change gear. Check that these and the workspeed pick-off gears are adequately lubricated and not too tightly meshed.

116. Press the master 'Start' button. The wheel and the work will rotate.

117. Turn the feed handwheel to advance the wheel and immediately the wheel touches the work, cease turning and press the rapid throw-out lever. Press the master 'Stop' button.

118. Note the infeed setting on the handwheel scale.

119. Move the traverse control lever to the left and set the left hand traverse stop so that it contacts the lever. Slacken the trip locknut and adjust the trip screw until the traverse control lever springs to the vertical position. Tighten the locknut.

120. Set the rapid throw-out trip so that it is depressing the plunger behind the traverse control lever.

121. Turn the faceplate (or Chuck) 1½ turns (540°) anti-clockwise by hand.

122. Move the traverse control lever to the right and set the right hand traverse stop so that it contacts the lever. Slacken the trip locknut and adjust the trip screw until the traverse control lever springs to the vertical position. Tighten the locknut.

123. Loosen the two knurled nuts on the front of the feed handwheel. Move the feed stop forward and turn the knurled stop ring so that its integral stop contacts the left hand edge of the feed stop.

124. Turn the feed handwheel to advance the grinding wheel the thread depth distance, lock the feed stop and tighten the two nuts on the handwheel.

125. Turn the feed handwheel to its original setting as noted in para. 31.

126. Set the 'Coolant' switch to 'Intermittent'; and the 'Auto Return' switch, if incorporated, to 'R.H. Auto'.

127. Open the coolant cock.

128. Position the splash guard.

129. Raise the rapid advance lever on the left hand side of the feed unit.

130. Press the master 'Start' button, move the traverse control lever to the left and then, without delay, turn the feed handwheel slowly, continuously and deliberately so that the grinding wheel advances and reaches full depth when the work has rotated 180°.

131. The work will traverse across the face of the wheel and when the full thread length has been ground the wheel will automatically, rapidly retract and the work will stop.

27. Release the screw in the carrier prong, remove the workpiece and detach the carrier. Subsequent components are now mounted as follows:-

(a) Mount the carrier to the pre-roughed workpiece (do not tighten the carrier lockscrew).
(b) Mount the assembly in the locator and secure the carrier prong to the peg as previously detailed.
(c) Slowly rotate the workpiece until the dial indicator needle registers the reversal point; secure the carrier lockscrew.
(d) Remove the workpiece and carrier and mount the assembly between the machine centres in this attitude. Proceed as above for all subsequent components in the batch.

39RA HOB GRINDING ATTACHMENT

INTRODUCTION

28. The hob grinding attachment Fig. 8 will produce high precision hobs of up to and including 7 in. (178 mm) maximum diameter. The attachment spindle incorporates a self-contained drive motor; spindle lubrication being effected by an oil mist system. Grinding wheels up to a maximum of 4 in. (100 mm) diameter may be mounted with the attachment.

ATTACHMENT MOUNTING

29. Prior to mounting the attachment it will be necessary to remove the external spindle unit from the wheelhead drum. Remove the belt cover and drive belts also the back guard plate. Slide off the top cover and remove the side wheel guards. Disconnect the oil return pipes from the spindlehead and fit the straight connector to prevent the ingress of dirt into the system. Remove any attachment mounted to the external spindle attachment face, also the spindle retaining nuts. Arrange suitable lifting tackle and remove the external spindle unit from the wheelhead drive.

30. Thoroughly clean the attachment and wheelhead abutment faces and mount the attachment to the wheelhead locating tenon and dowel.

31. Mount the oil mist lubrication unit in a convenient position and connect the air supply. Secure the flexible oil mist supply hose to the attachment inlet nozzle. Set the lubrication unit control valve to supply 5 to 6 drops per minute.

NOTE: A working pressure of 14 P.S.I. (1.0 kg/cm^2) is recommended. Insert the motor lead into the pre-wired socket on the electrical cabinet; operation is controlled from the machine control station.

WHEEL ADAPTORS.

32. The standard wheel adaptor supplied with the unit will accomodate grinding wheels of $\frac{3}{4}$ in. (19 mm) bore and $\frac{1}{2}$ in. (12 mm) thick. Listed below are optional wheel adaptors for alternative wheel sizes.

Grinding Wheels

Bore	Thickness
$\frac{3}{4}$ in. (19 mm)	$\frac{1}{4}$ in. (6 mm)
$1\frac{1}{4}$ in. (31 mm)	$\frac{1}{4}$ in. (6 mm)
$1\frac{1}{4}$ in. (31 mm)	$\frac{1}{2}$ in. (12 mm)

33. Wheel adaptors are located to the taper on the spindle nose and retained by a slotted $\frac{1}{4}$ in. B.S.F. L.H. retaining screw. To withdraw the adaptor unit from the spindle nose; release the retaining screw and insert the special $\frac{1}{4}$ in. 22 T.P.I. extractor screw in the adaptor, tighten the extractor screw to withdraw the assembly from the spindle nose.

GENERAL

34. From a position parallel to the work axis the spindle may be adjusted as follows.

96. Select, mount, true and balance a 50mm (2 in.) wide grinding wheel as instructed in Section G.

NOTE: The wheel width should always be approximately 25% greater than the thread length.

97. Mount the crusher unit. If the 16 GMB is employed, remove the dummy plug from the electrical cabinet and insert that of the crusher.

98. Set the coolant cock to half open, turn the 'Coolant' switch to 'Continuous' and set all other switches to 'Off'. Press the 'Master Start' button and turn the grinding wheel by hand until it is soaked in coolant. Press the 'Master Stop' button and close the coolant cock. Turn the 'Coolant' switch to 'Off' and the wheelhead switch to 'High Grind', press the 'Master Start' button and then, when the oil has been centrifugally expelled from the wheel, press the master 'Stop' button.

99. Set the grinding wheel to zero helix.

100. Set the 'Wheelhead' switch as follows:

(a) to 'Auto Crushing' if the 16 GMB crusher is fitted and is to be operated automatically, or

(b) to 'Hand Crushing' if the 16 GMC crusher is fitted, or

(c) to 'Hand Crushing' if the 16 GMB is fitted and is to be manually operated.

101. Select and mount the workspeed pick-off gears in the gearbox. A very slow workspeed is usually selected for plunge grinding.

102. Set the workspeed range lever in the gearbox. The low range is normally selected for plunge grinding.

103. If flute change gears are fitted, remove at least one of them.

104. Select and mount the pitch change gears on the top of the workhead.

105. Select the workhead pitch ratio to 'High' or 'Low' as required and move the right hand lever to engage the spindle drive.

106. Turn the 'Coolant' switch to 'Continuous' and fully open the crusher coolant supply cock.

107. Press the master 'Start' button and crush the wheel. Refer to Section F.

NOTE: If hand crushing is employed, the roller must be fed slowly, deliberately and continuously into the wheel so that the wheel is 'crushed' and does not grind the roller. Immediately the form is complete on the wheel, raise the roller.

108. If the work is to be mounted between centres, clean the bore of the tailstock barrel before fitting its centre.

109. Clean the workspindle bore and fit either a collet or a centre as required.

110. If two centres are used, fit a work carrier to the work.

111. Clean and lubricate the centre holes in the workpiece, position the tailstock and mount the work.

CAUTION: Do not overtighten the tailstock securing nuts. No.46 Machines have a safety screw on the tailstock and although not essential it can be used for this type of component. Refer to Section B.

112. Turn the feed handwheel to retard the wheel 15 mm. ($\frac{5}{8}$ in.) clear of the largest diameter of the work and then raise the rapid advance lever on the left hand side of the feed unit.

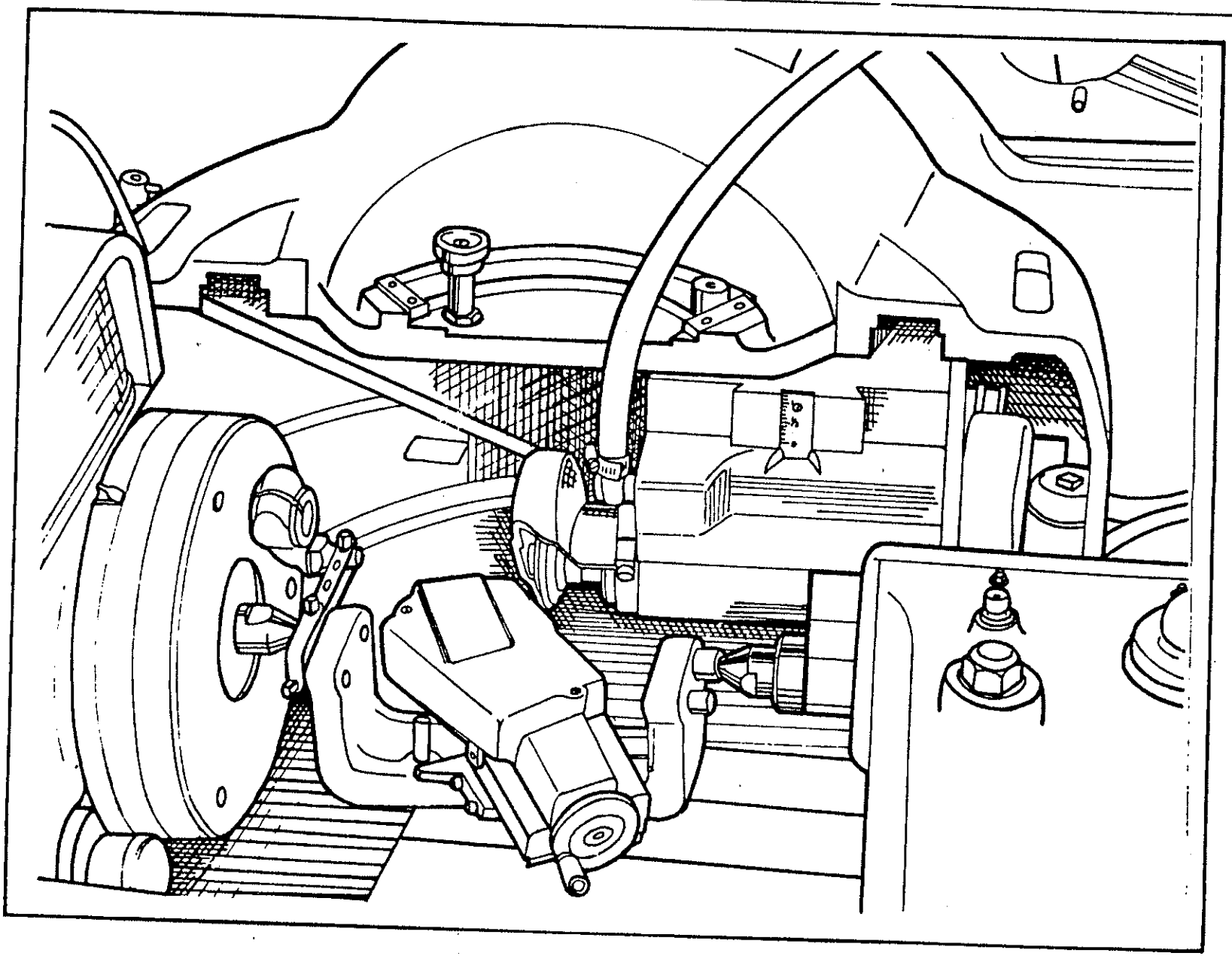


Fig. 8 39RA Hob Grinding Attachment

(a) Radial displacement through 90° in the vertical plane. Release the locknut below the spindle head and adjust through 90°; intermediate positions are set with a sine bar.

(b) Vertical adjustment to 1½ in. (38 mm) above the work centre line. Release the locknuts at the side of the vertical slide and adjust the slide position either by interposing slip gauges between the facing on the unit body or alternatively by direct reading on the attachment scale.

(c) Radial displacement through 180° in the vertical plane. This adjustment provides a method of accurately producing symmetrical hob forms, each flank may be ground from identical settings. Release the two hexagon locknuts located in the recesses on the attachment casting, utilising the special cranked spanner provided. Swing the unit clockwise from stop to stop and secure the locknuts.

35. The wheelhead drum is displaced radially to lay over the grinding wheel at the helix angle of the work form.

36. Limited drive belt tension can be achieved by rotating the body of the drive motor in its eccentric housing; this is achieved by releasing the securing screws and inserting a tommy bar in the end plate apertures. When the correct tension is achieved lock the securing screws.

37. Grinding wheel peripheral speeds may be varied by mounting alternative drive pulleys. Three optional pulleys are available to provide the following spindle speeds, 3250 to 4600 and 7100 r.p.m.

WHEEL DRESSING

38. The wheel may be dressed to a multi-rib form utilising the multi-ribbed diamond dresser (Section C) or alternatively a single point wheel form can be produced employing the 27VC dresser mounted between the machine centres (Fig. 8). A suitable crushing roller and mounting arbor may also be employed to form the wheel, the assembly being mounted between the machine centres. For wheel forming operations with the multi-ribbed wheel crusher the attachment spindle will be rotated using a cranked handle inserted through the aperture in the attachment casting to locate drive dogs on the motor pulley.

39. The method of setting and operating the machine for relieving is described in 'Setting Instructions' and 'Calculations for Fluted Work'.

PARA'S 40 TO 60 INCLUSIVE, DELETED

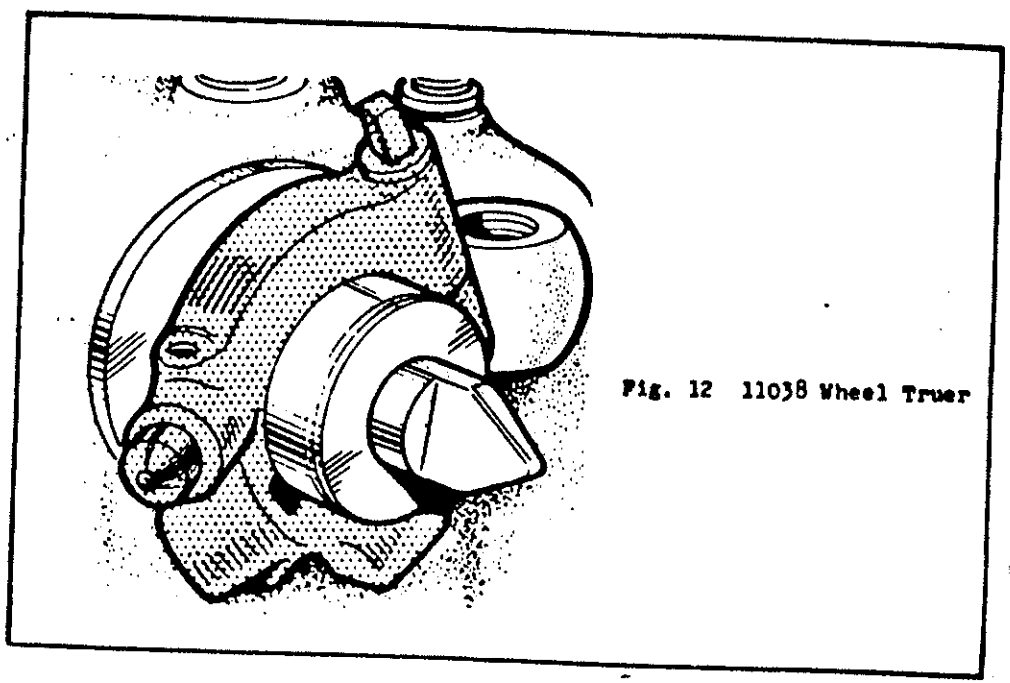


Fig. 12 11038 Wheel Truer

INTRODUCTION

61. The truer (Fig.12) consists of a bracket incorporating location holes for standard diamond holders; grub screws secure the holders for operation. The unit is designed to encompass the tailstock barrel to which it is secured by a square head lock screw, the unit being secured with the truing diamond in a position slightly below the wheel centre line.

TRUING THE WHEEL

62. Release the tailstock retaining clamp and adjust the position until the truing diamond is positioned at the left hand side of the wheel (the tailstock barrel fully extended). Truing is effected by operating the barrel lever to traverse the diamond from left to right across the face of the wheel. Note the direction of traverse and the angle at which the diamond is presented to the wheel Fig.13: Truing must not be attempted on the return stroke.

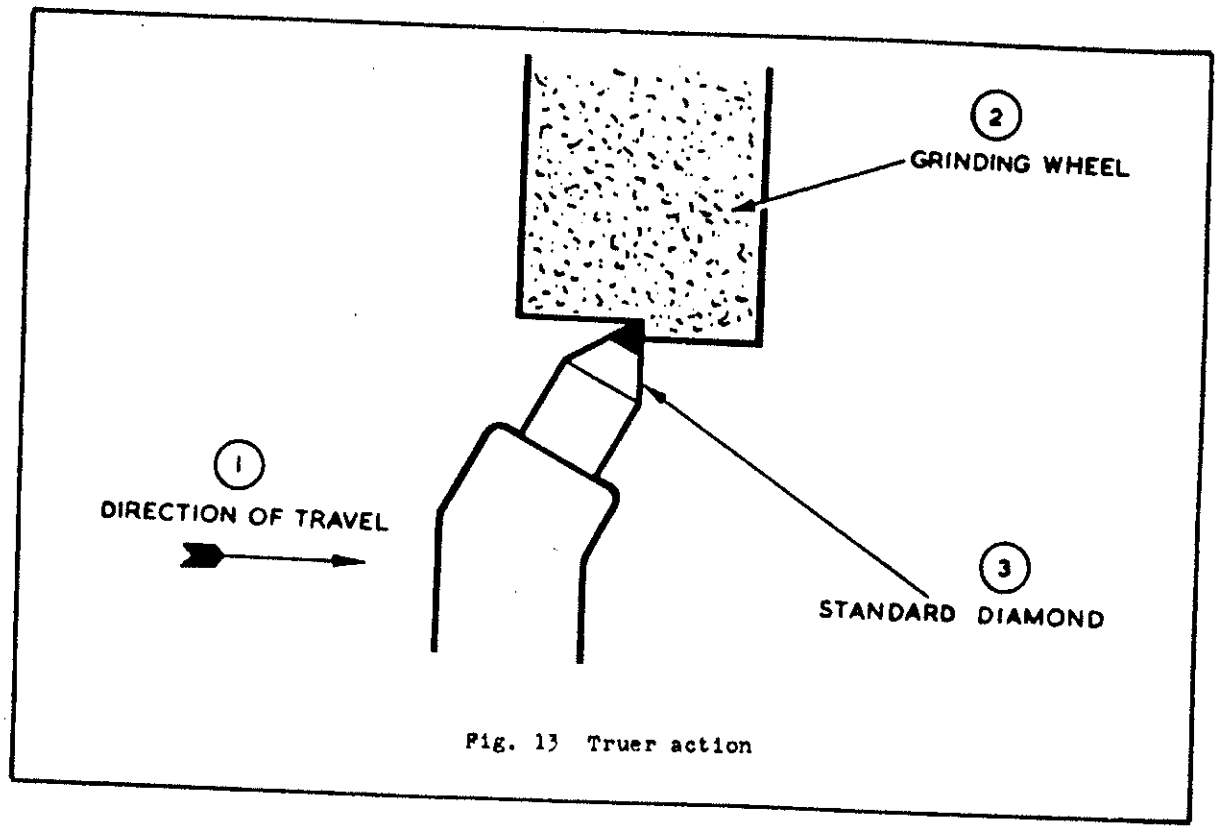


Fig. 13 Truer action

INTRODUCTION

1. The basic coolant system consists of a free-standing tank and motor driven impellor pump to be located in the recess at the left-hand side of the machine base. The coolant pump has a water rating of 12 imp. gall./min. (54 litres/min.) and the tank capacity is 30 imp. gall. (136 litres). Coolant is discharged via a flexible armoured hose to the adjustable nozzle at the wheelhead; coolant flow being regulated by a manually operated control valve.

2. Always use the maximum coolant flow possible and ensure that the flow is directed at the intersection of the wheel and workpiece. Maintain the maximum level in the coolant tank to ensure that the pump will at all times be totally immersed. Do not permit coolant oil to flow onto a stationary wheel; to do so will result in the wheel assuming a state of imbalance and may result in breakage when starting up.

3. The coolant tank should be drained and thoroughly cleaned at regular intervals. Re-plenish with fresh coolant oil. Avoid continuous 'topping up', this will lead to an accumulation of sludge in the tank which will, by the nature of the coolant oil be slow to settle, recirculation will therefore occur to the detriment of the component finish.

COOLANT OILS

4. The correct choise of coolant oil is of prime importance. The principle purpose of a coolant oil is that of heat dissipation but coolant oils fulfilling only this requirement will not be adequate in producing the best results with these machines. Exhaustive tests have proven the coolant oils listed below to be superior for all operations with these machines; wheel glaze and 'clogging' are practically eliminated, thus finer wheel forms can be readily maintained. The coolant oils recommended below are also ideal when forming the wheel by the 'crushing' method, permitting the crushing roller to be fed into the wheel with the minimum of effort.

NEVER USE SOLUBLE OIL WHEN CRUSHING

5. Recommended proprietary coolant oils:-

Alexander Duckham & Co. Ltd.
'Kemcut 300'
'Adformal EP7'

Shell Oil Co. Ltd.
'Shellcut TG'

Edgar Vaughan & Co. Ltd.
'Frapol TG'

Castrol Fletcher Miller.
'Illocut TG.20' medium
'Illocut TG.40' heavy

EXTRA EQUIPMENT

6. [redacted] coolant clarification equipment is available as non-standard and two methods of installation are illustrated in Section 'A'.

Method 1. Twin single rotor units, model 20-15-0 with M.S.E.50 imp. gall. (227 litres) capacity tank. Used coolant is gravity fed into the top of the clarifier rotors from where it passes into the storage tank to be discharged to the wheelhead.

Method 2. Twin single rotor units, model 20-15-0 with M.S.E.50 imp. gall. (227 litres) capacity tank, J & E Hall refrigeration unit with integral 'MATRIX' storage tank. Used coolant is gravity fed into the top of the clarifier rotors, and passes into the storage tank. Clean tepid coolant is discharged from the storage tank and passes through the refrigeration unit to the integral tank and so to the wheelhead.

M.S.E. CENTRIFUGAL CLARIFIERS

INTRODUCTION

7. This is a condensed version of M.S.E. Technical Publication No. 28 for Single Rotor (Series 20) and Twin Rotor (Series 40) Clarifiers. Wiring diagrams can be supplied on request.

8. They are manufactured as basic units with three standard inlet heights (22, 18 and 15 inches). A choice of tank capacities is provided for 22-inch and 18-inch inlet units but the 15-inch inlet unit has only one size of tank.

9. Each basic unit has three numbers to denote the model. The first is the series number, the second denotes the inlet height (in inches) and the third is the tank capacity (in Imperial gallons).

10. A letter suffix is added to denote the three-phase operating voltage supply as follows:

'J' : 400/440V. 50 c/s.
'K' : 365/400V. 50 c/s.
'M' : 220/240V. 50 c/s.
'N' : 480/520V. 50 c/s.

Clarifiers can be specially supplied for operation on certain other supply voltages.

11. Alternative electric systems, are available for both series (the appropriate system is selected for incorporation into the clarifier when the unit is ordered).

PRINCIPLE OF OPERATION

12. Series 20 Clarifiers have a single rotor and one inlet and Series 40 Clarifiers have two rotors and two inlets.

13. Dirty coolant is fed into the sloping inlet pipe and passes into the open top rotor which is driven at high speed. It is then deflected by the centre cone toward the bottom where centrifugal force acts and packs foreign matter into a cake against the wall of the rotor liner.

14. Clarified coolant overflows through the hole in the top of the vane assembly into a storage tank and is then pumped back direct to the machine or to its coolant reservoir or auxiliary tank. Output must not exceed the input capacity stated on the instruction plate otherwise the rotor motor will be overloaded.

15. Each rotor has a long life removable flexible liner which is shaped to the inner contours of the rotor and is secured inside the rotor by a removable vane assembly. This assembly consists of an open top ring and several vertical Paddle type vanes.

PIPE CONNECTION - INLET

16. Connect the dirty coolant line of the machine to the sloping inlet on the clarifier lid but ensure that the lid can be opened without having to disconnect the pipe.

17. All clarifiers require 2-inch bore tubing, the ends being secured by hose clips.

(c) to 'Hand Crushing' if the 16 GMC crusher is to be employed, or

(d) to 'Hand Crushing' if the 16 GMB crusher is to be manually operated.

66. Select and mount the workspeed pick-off gears in the gearbox.

67. If flute change gears are fitted, remove at least one of them.

68. Set the workspeed range selector lever in the gearbox.

69. Set the workhead pitch ratio selector lever and move the right hand lever to engage the spindle drive.

70. Select and mount the pitch change gears on the top of the workhead.

71. Mount the appropriate wheel forming unit and dress or crush the wheel as detailed in Sections C and F respectively.

NOTE: Maximum continuous coolant is required for crushing.

72. Clean the bore of the tailstock barrel and fit a centre. Clean the workspindle bore and fit either a collet or a centre as required.

73. If two centres are used, fit a work carrier to the work.

74. Clean and lubricate the centre holes in the workpiece, position the tailstock and mount the work.

CAUTION: Do not overtighten the tailstock securing nuts.

75. Turn the feed handwheel to retard the wheel $\frac{3}{8}$ in. (15.8 mm) clear of the work and then raise the rapid advance lever on the left hand side of the feed unit so that the wheel advances to almost touch the work.

76. Remove the finally driven pitch change gear from the top of the workhead and engage and turn the pitching handle until the right hand end of the work is just clear of the left hand side of the wheel. Press the 'Master Stop' button to ensure that all motors have stopped. Move the traverse control lever to the right and set and adjust the right hand traverse stop so that it contacts the lever. Slacken the trip locknut and adjust the trip screw until the traverse control lever springs to the vertical position. Tighten the locknut.

77. Turn the pitching handle until the left hand end of the work is just clear of the right hand side of the wheel. Move the traverse control lever to the left and set and adjust the left hand traverse stop so that it just contacts the lever. Slacken the trip locknut and adjust the trip screw until the traverse control lever springs to the vertical position. Tighten the locknut.

78. Set the rapid throw-out trip so that it is approximately 2 mm. (1/32 in.) to the left of plunger behind the traverse control lever, i.e. so that the wheelhead throw-out mechanism will operate immediately after the full traverse of the work across the wheel face.

79. Remove the pitching handle and replace the pitch change gear. Check that these and the workspeed pick-off gears are adequately lubricated and not too tightly meshed.

80. Set the control station switches as follows:

Wheelhead	High Grind
Workhead	R.H.
External/Internal	On. External
Coolant	Intermittent
Hob Grinding	Off
Speed Return	Fast Return
* Auto Return	R.H. Auto

* not all machines have this switch.

LUBRICATION

1. Machine and wheelspindle lubrication is supplied by two mechanical pump units.

   (a) The gearbox pump. This supplies lubricant to a reservoir at the top of the gearbox casting from where it gravity feeds to the gearbox lubrication points.

   (b) The base pump. This is a dual purpose pump having two separate sump units for both machine and spindle lubricant, located at the rear of the hinged cover plate on the right hand side of the machine base.

2. Workhead lubricant is gravity fed from the workhead reservoir, workslide lubrication being supplied via. a distributor mounted in the gearbox, this also supplies lubricant to the leader nut housing bevel gear also the leadscrew and nut and rapid throwout nut on the feed unit.

3. Wheelspindle lubricant is circulated to the internal/external spindle and returns to the spindle oil side of the base pump unit to be recirculated.

4. Wheelhead slides and leadscrew are lubricated from a reservoir at the lower left hand side of the wheelhead.

5. All machine major components are lubricated through pre-set needle regulator valves (figs. 1 and 2). These valves should not require re-adjustment but should the necessity arrise flow settings for each valve are as follows.

Regulator Valve Flow Settings Fig. 1 and 2.

Valve	Settings (drops per minute)
A	8
B	2
C	2
D	2
E	2
F	2
G	120

6. It is essential that the slide ways are flooded prior to the workslide being traversed. Regularly drain and refill the gearbox with the specified lubricant.

   Note: An accumulation of foreign particles in the lubricant will reduce the efficiency of the magnetic clutches.

7. When the wheelhead is inclined at a L.H. helix of 30° or more lubricant should be pumped through the nipple on the wheelbead rear pulley bearing housing. This bearing will not receive normal lubrication whilst the wheelhead is inclined at the angle stated above.

RECOMMENDED LUBRICANTS

8. All machine lubrication points should be replenished in accordance with the frequency chart using either the lubricant specified below or a suitable alternative of equivalant specification.

9. Spindle Oil: Mobil 'Velocite 6'

Specific gravity at 15.56°C	0.882
Viscosity Kinematic at 37.78°C	10 centistrokes
Minimum open flash point	154°C
Maximum pour point	13°C
Viscosity index (minimum)	75

10. Machine OIL: Mobil D.T.E. Heavy Medium

Specific gravity at 15.56°C	0.884
Viscosity Kinematic at 37.78°C	63.6 centistrokes
Minimum open flash point	210°C
Maximum pour point	11.11°C
Viscosity index (minimum)	97

11. Gearbox Oil: Mobil D.T.E. Light *

Specific gravity at 15.56°C	0.874
Viscosity kinematic at 37.78°C	32 centistrokes
Minimum open flash point	201°C
Maximum pour point	11°C
Viscosity index (minimum)	103

12.

Lubrication Schedule		
Daily	1	Lubricate with oilgun.
Weekly	2	Lubricate with oilgun.
	3	Inspect level. Top up as required.
	4	Inspect level. Top up as required.
	5	Filler plug and dipstick. Top up as required. (Machine oil)
	6	Valve to be fully opened to flood base oil pockets.
Every 3 months	7	Drain and refill (spindle oil).
	8	Drain and refill (machine oil).
Yearly	9	Renew oil cleaner felt.

* IMPORTANT: This gearbox oil has been selected only after extensive research. Even when using an oil having apparently equivalent characteristics, it is possible that additives in the equivalent oil could render it unsuitable for direct substitution.

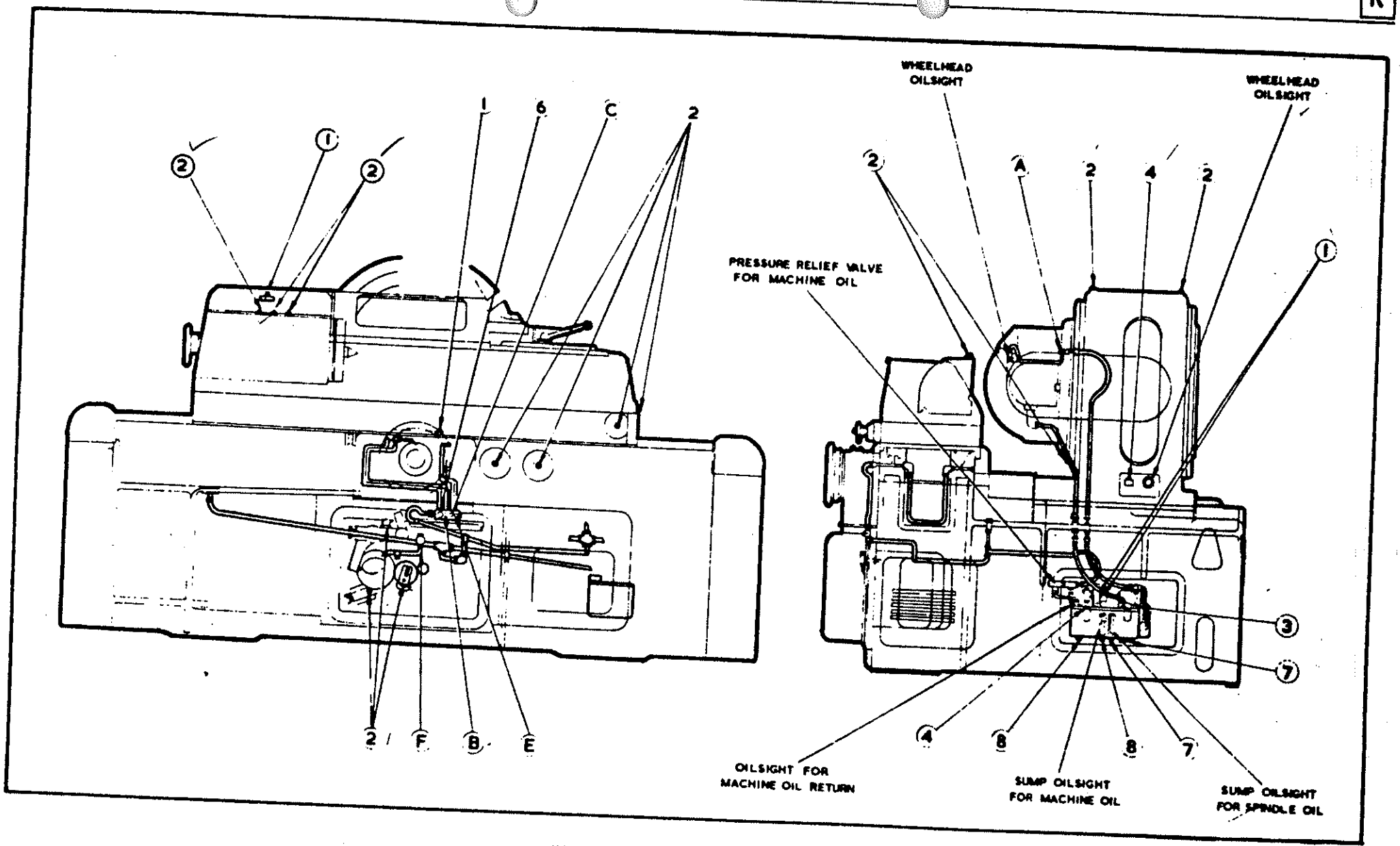


Fig. 1 Lubrication Diagram

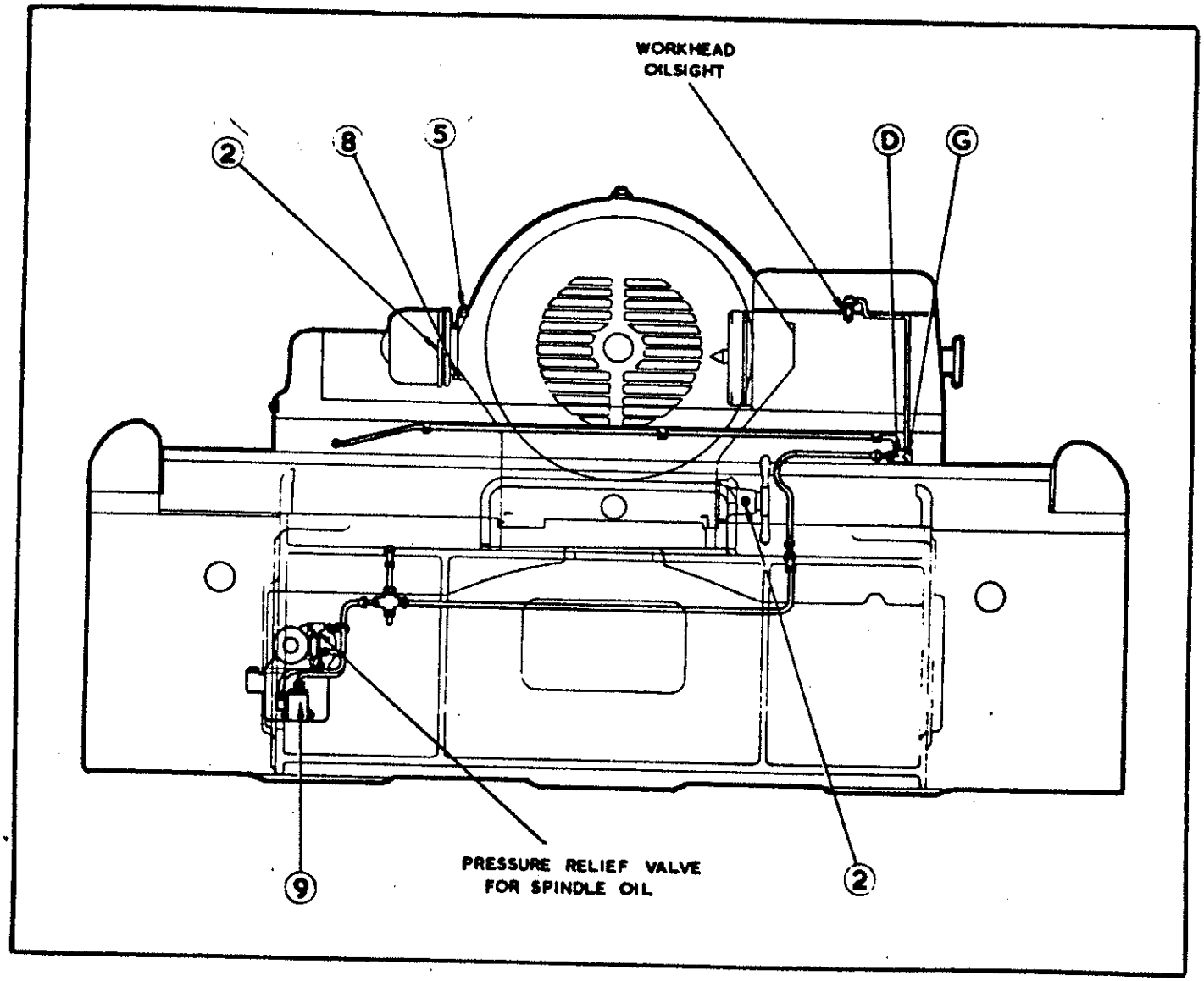


Fig. 2 Lubrication Diagram

NOTES ON CAMS AND DIAMONDS

The following information has been compiled with a view to helping in the selection of cams for use on the Matrix Thread Grinding Machine.

These notes cover the latest range of Tap Form Cams, which are also suitable for producing Thread Rolls for Taps (see notes dealing with Cams for B.S.I. Taps and Thread Rolls for Taps.)

The previous method of using factored wheels for Sharp Vee Threads, has been forced to concede to Actual Formed Wheels in the interest of higher productivity. There is no hard and fast rule, each particular job should be considered before deciding the type of Cam and Diamond which will be used. A glance at the table concerning Sharp Vee Threads will immediately show which Cam and appropriate Diamond can be used for any particular thread on this range.

It should be noted that when ordering Diamonds, it is essential that the pitch for which the Diamond is to be used must be stated. This is due to there being three types of Diamonds of varying exposure, viz.: Type 1 (Standard), Type 2 (Medium), Type 3 (Large). For example, a .007" Flat Vee Diamond for 20 T.P.I. Whitworth Thread would not be suitable for 10 T.P.I. Whitworth Form due to the fact that the exposure of the Diamond for the 20 T.P.I. is insufficient to clear the depth of a 10 T.P.I. Thread.

CAMS FOR STANDARD WHITWORTH PITCHES

T.P.I.	Gauge proportions Size of Flat Vee Roughing Diamond	Radius on Cone Diamond
3P to 26P inclusive	.007"	.005"
27P to 52P inclusive	.003"-.004"	.0025"
54P to 60P inclusive	.003"	.002"
61P to 72P inclusive	.002"	.0017"

For pitches finer than 72 T.P.I. the method of truing ultra-fine threads is used.

CAMS FOR BA PITCHES

Designation	Gauge proportions Size of Flat Vee Roughing Diamond	Radius on Cone Diamond
0.BA to 3.BA inclusive	.007"	.005"
4.BA to 9.BA inclusive	.003"-.004"	.0025"
10.BA	.003"	.002"
11.BA to 12.BA inclusive	.002"	.0017"

13.BA to 20.BA inclusive - the method of truing ultra-fine threads is used.

CAMS FOR PRODUCING TAPS AND THREAD ROLLS FOR TAPS TO B.S.I. SPEC. 1951
ENGRAVED:- B.S.I. TAPS

Whitworth Pitches	Size of Flat Vee Roughing Diamond	Radius on Cone Diamond
4P to 22P inclusive	.007"	.005"
24P to 32P inclusive	.005"	.0035"
36P to 40P inclusive	.003"-.004"	.0025"
48P	.003"	.002"
60P	.002"	.0017"

BA Pitches	Size of Flat Vee Roughing Diamond	Radius on Cone Diamond
0.BA to 2.BA inclusive	.007"	.005"
3.BA to 5.BA inclusive	.005"	.0035"
6.BA to 8.BA inclusive	.003"-.004"	.0025"
9.BA & 10.BA inclusive	.003"	.002"
11.BA & 12.BA inclusive	.002"	.0017"

For BA pitches finer than 12.BA we suggest the use of Sharp Vee Cams factored 2 : 1

PROPORTIONS GIVEN BY B.S.I. TAP CAMS

Whitworth Pitches	Major Diameter	Eff. Dia. Nominal	Core Diameter
3P	+.0035"	"	-.0035"
3½P	+.0033"	"	-.0033"
3½P & 4P	+.003"	"	-.003"
4½P x 5P	+.0028"	"	-.0028"
6P	+.0024"	"	-.0024"
7P	+.0022"	"	-.0022"
8P	+.002"	"	-.002"
9P to 11P inclusive	+.0018"	"	-.0018"
12P & 14P	+.0016"	"	-.0016"
16P	+.0014"	"	-.0014"
18P to 22P inclusive	+.0012"	"	-.0012"
24P to 40P inclusive	+.001"	"	-.001"
Pitches finer than 40P to 60P inclusive	+.0009"	"	-.0009"

BA Pitches	Major Diameter	Eff. Dia. Nominal	Core Diameter
0.BA to 4.BA incl.	+.001"	"	-.001"
5.BA to 12.BA incl.	+.0009"	"	-.0009"

For pitches finer than 12.BA use Sharp Vee Cams factored 2 : 1

CAMS FOR PRODUCING CRUSHING ROLLERS FOR PRODUCTION WORK (DEEP CORE)

These cams produce a Component which is -.004" on core diameter. The range of Cams and Diamonds to be used are the same as for Gauge Proportions - Whitworth and BA up to 10.BA, over 10.BA core diameter is -.002"

NOTES ON SHARP VEE THREADS

Cams supplied on this range are to produce an Actual wheel for the first pitch engraved on the cam. Care should be taken to see that the correct size of Vee Diamond is used.

Where production rate must be high, and large quantities of components are being made (such as Tap production), we strongly recommend the use of an Actual formed wheel, due to the large saving in wheel dressing time, and also the high output per wheel dressing.

For small quantities of work, however, it is more economical on diamonds to use a factored wheel. (i.e. Dressing the wheel for twice the pitch required on component - the second pitch engraved on cam). Here it is possible to use a more robust diamond. A .007" Vee Diamond can be used to produce all factored wheels.

Briefly, where the pitch of the component equals the first pitch engraved on Cam, an actual wheel can be used.

Where the pitch of the component equals the second pitch engraved on Cam, a factored wheel is used.

CAMS FOR METRIC 60° SHARP VEE THREADS

Pitch	Flat of Vee Diamond
0.4 mm & 0.45 mm	.0015"
0.5 mm to 0.75 mm	.002"
0.75 mm to 1.2 mm	.003"
1.25 mm to 1.5 mm	.005"
1.6 mm to 6.0 mm	.007"

Finer pitches than 0.4 mm must be produced with factored wheel.

60° SHARP VEE THREADS U.S.S.

Pitch	Flat of Vee Diamond
4P to 16P	.007"
18P to 20P	.005"
22P to 36P	.003"
38P to 56P	.002"
60P	.0015"

Finer pitches than 60 T.P.I. must be produced with factored wheel.

S.I. THREADS. RADIUSED CORE

These cams will only be supplied where Strict S.I. is definitely specified. The use of a radiused core is purely arbitrary and has, of late, been superceded by the truncated sharp vee form having flat crest and sharp vee root.

55° SHARP VEE THREADS

4P to 30P Actual Wheel with .007" flat vee diamond. Factoring for finer pitches and factoring where necessary for 'NOT GO' work.

CAMS TO PRODUCE B.A. SHARP VEE THREADS

0.BA to 20.BA. All factored using .007" flat vee diamond.

C.E.I. THREADS

20p to 32P requires a .007" flat vee roughing Diamond and a .005" radiused cone Diamond.

40P to 56P requires a .003/4 flat vee roughing Diamond and a .0025" radiused cone Diamond.

CAMS FOR UNIFIED THREADS B.S.1580-1953

UNIFIED GAUGES

Use standard 60° Sharp Vee Cam.

UNIFIED TAPS

T.P.I.	Vee Roughing Diamond	Radius on Cone
4 to 12 inclusive	.007"	.005"
13 to 16 inclusive	.005"	.0035"
18 to 24 inclusive	.004"	.0025"
Pitches finer than 24 T.P.I. factored 2 x 1	.007"	.005"

EXTERNAL THREADS ON COMPONENTS

These cams produce a from having a radii of 108P at Crest and root.

Further information regarding the various alternative forms of Unified threads may be obtained from our Drawing No. 11710. This drawing illustrates the type of cam we suggest using for all types of gauge manufacture and also production work.

FURTHER DATA CONCERNING OIL SPECIFICATIONS

OIL	VISCOSITY S.S.U.		VISCOSITY INDEX MINIMUM	VISCOSITY CENTISTOKES	
	100°F	210°F		100°F	210°F
D.T.E. LIGHT	-	-	103	31.5	5.26
D.T.E. HEAVY MEDIUM	925	53	97	63.5	8.10
D.T.E. BB	-	-	95	197.5	16.5
VACTRA HEAVY MEDIUM	-	-	95	61	7.6
VACTRA No. 2	-	-	-	72	8
VACUOLINE 1405	-	-	-	31.5/34.2	5.11
VELOCITE No. 3	-	-	-	2.3	-
VELOCITE No. 6	-	-	-	10	2.6

GREASES

MOBILUX No. 2

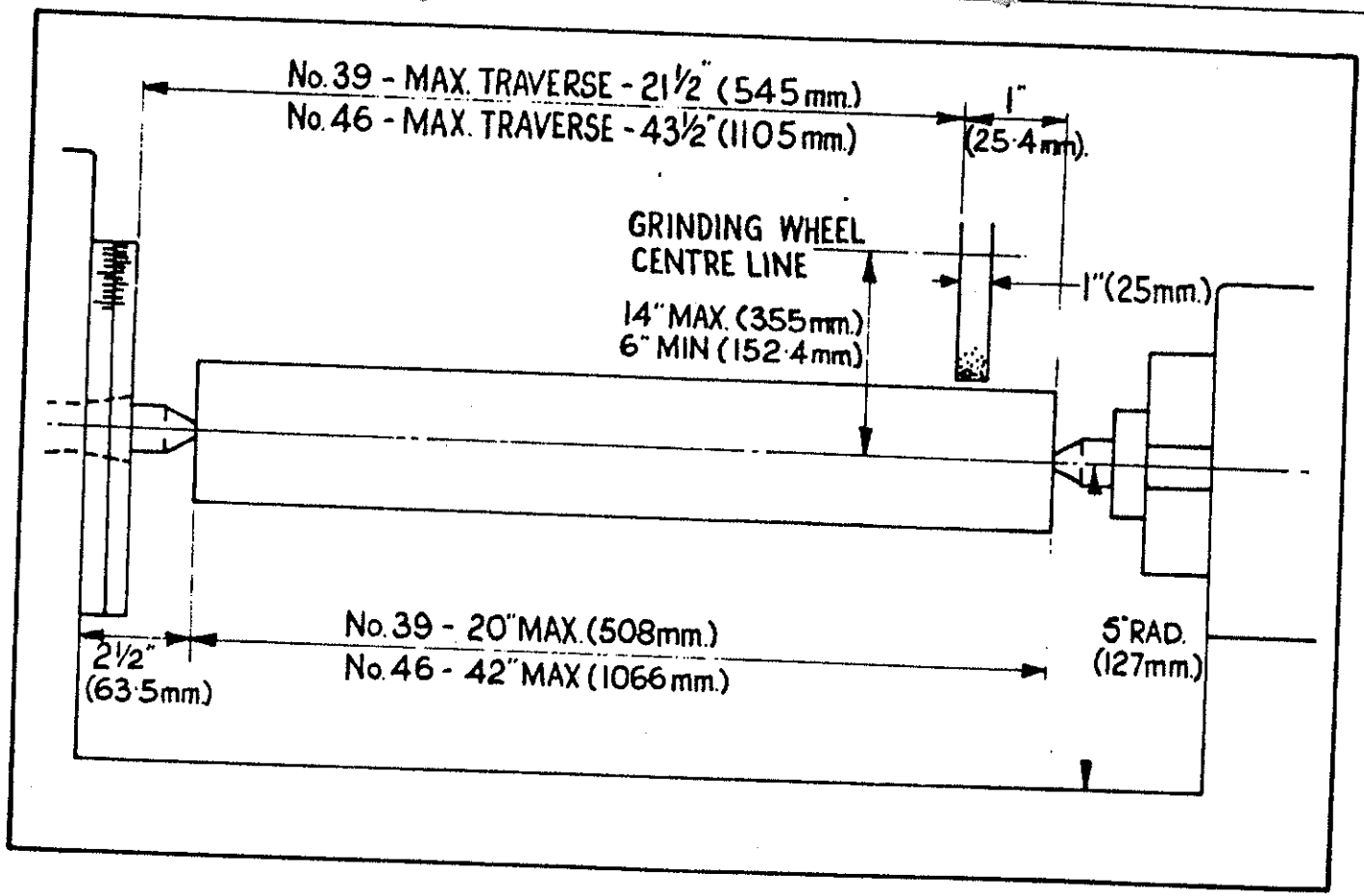
Lithium base grease
No. 2 Classification Consistency
Worked penetration 265/295
85% Mineral Oil
500 S.U.S. ay 100°F
Minimum Drop Point 350°F

MOBILUX No. 3

Lithium base grease
No. 3 Classification Consistency
Worked penetration 220/250
81% Mineral Oil
500 S.U.S. ay 100°F
Drop Point 350°F

ANDOC

Soda Base grease
Worked penetration 220
34% soap content with S.A.E.type Oil
480 S.U.S. at 100°F
Drop Point 350°F



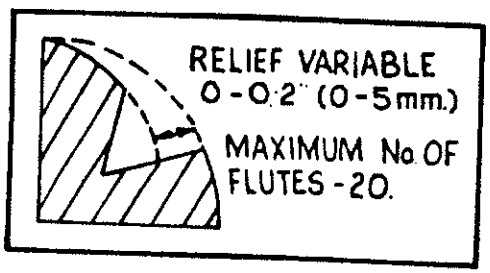


Fig. 1 Capacity chart

SPECIFICATION	No. 39 UNIVERSAL		No. 46 UNIVERSAL	
MAXIMUM DIAMETER ADMITTED	10"	254 mm	10"	254 mm
MAXIMUM LENGTH BETWEEN CENTRES	20"	508 mm	42"	1066 mm
MAXIMUM LENGTH GROUND AT ONE SETTING	19"	482 mm	41"	1041 mm
MAXIMUM SWING INTO GAP	12"	305 mm	12"	305 mm
WIDTH OF GAP IN FRONT OF FACEPLATE	2½"	63.5 mm	2½"	63.5 mm
MAXIMUM COLLET CAPACITY	1½"	38 mm	1½"	38 mm
MAXIMUM HELIX ANGLE, R.H. OR L.H.	45°	45°	45°	45°
WORKHEAD AND TAILSTOCK CENTRES	No. 4 M.T.	No. 4 M.T.	No. 4 M.T.	No. 4 M.T.
PITCH RANGE	60 T.P.I. to 12" LEAD	0.42 to 305 mm	60 T.P.I. to 12" LEAD	0.42 to 305 mm
MAXIMUM PITCH CORRECTION	0.025" PER FOOT	0.2 mm per 100 mm	0.0125" PER FOOT	0.1 mm per 100 mm
RELIEF VARIABLE	0 - 0.2"	0 - 5 mm	0 - 0.2"	0 - 5 mm
NUMBER OF WORKHEAD SPEEDS	20	20	20	20
RANGE OF WORKHEAD SPEEDS	1/3 to 60 R.P.M.	1/3 to 60 R.P.M.	1/3 to 60 R.P.M.	1/3 to 60 R.P.M.
WORK RETURN SPEEDS	25.4, 80 R.P.M. OR WORKSPEED	25.4, 80 R.P.M. OR WORKSPEED	25.4, 80 R.P.M. OR WORKSPEED	25.4, 80 R.P.M. OR WORKSPEED
WORKHEAD MOTOR	¾ H.P.	¾ H.P.	¾ H.P.	¾ H.P.
WHEELHEAD MOTOR	3½/1½ H.P.	3½/1½ H.P.	3½/1½ H.P.	3½/1½ H.P.
CRUSHING MOTOR	1/3 H.P.	1/3 H.P.	1/3 H.P.	1/3 H.P.
MAXIMUM TAPER ON DIAMETER	1 in 8	1 in 8	1 in 12	1 in 12
STANDARD GRINDING WHEEL SIZE	16" x 1" x 8"	408 x 25 x 205 mm	16" x 1" x 8"	408 x 25 x 205 mm
GRINDING WHEEL WIDTH LIMITS	⅜" to 3"	9.5 - 75 mm	⅜" to 3"	9.5 - 75 mm
CONSTANT OF LEADSCREW	5 T.P.I. (HIGH RATIO)	5 mm PITCH (HIGH RATIO)	5 T.P.I. (HIGH RATIO)	5 mm PITCH (HIGH RATIO)
	1¼ T.P.I. (LOW RATIO)	20.2 mm PITCH (LOW RATIO)	1¼ T.P.I. (LOW RATIO)	20.2 mm PITCH (LOW RATIO)
NO. OF GRINDING WHEEL SPEEDS	3	3	3	3
RANGE OF GRINDING SPINDLE SPEEDS	850 - 1540 R.P.M.	850 - 1540 R.P.M.	850 - 1540 R.P.M.	850 - 1540 R.P.M.
INTERNAL DIAMETERS GROUND	¾" to 9"	19 - 228 mm	¾" - 9"	19 - 228 mm
MAXIMUM HOB DIAMETER	7"	178 mm	7"	178 mm
MAXIMUM CHASER LENGTH	10"	254 mm	10"	254 mm
COOLANT TANK CAPACITY	30 GALLONS	136 LITRES	30 GALLONS	136 LITRES
COOLANT PUMP (WATER RATING)	12 GALLONS/MIN	54 LITRES/MIN	12 GALLONS/MIN	54 LITRES/MIN
NETT WEIGHT	5 TONS	5080 Kgs	5 TONS 17 CWT	5994 Kgs

Fig. 2 Machine specification

Helix angles based on pitch diameters.

OUTSIDE DIA. INCHES	THREADS PER INCH																						
	40	36	32	28	26	24	22	20	18	16	14	13	12	11	10	9	8	7	6	5½	5	4½	4
3/16	2°39'	2°59'	3°24'	3°57'	4°19'	4°44'	5°18'	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1/4	1°57'	2°11'	2°29'	2°52'	307'	3028'	3045'	4011'	4044'	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5/16	1032'	1043'	1057'	2015'	2026'	2040'	2056'	3015'	3040'	4011'	-	-	-	-	-	-	-	-	-	-	-	-	-
3/8	1016'	1025'	1036'	1051'	200'	2011'	2028'	2040'	2059'	3024'	3057'	-	-	-	-	-	-	-	-	-	-	-	-
7/16	105'	1012'	1022'	1034'	1042'	1051'	202'	2015'	2031'	2052'	3020'	3037'	3057'	4022'	-	-	-	-	-	-	-	-	-
1/2	0057'	103'	1011'	1022'	1029'	1036'	1046'	1057'	2011'	2029'	2052'	307'	3024'	3045'	-	-	-	-	-	-	-	-	-
9/16	0050'	0056'	103'	1012'	1018'	1025'	1033'	1043'	1055'	2011'	2031'	2044'	2059'	3017'	-	-	-	-	-	-	-	-	-
5/8	0045'	0050'	0057'	105'	1010'	1016'	1023'	1032'	1043'	1057'	2015'	2026'	2040'	2056'	3015'	-	-	-	-	-	-	-	-
11/16	0037'	0042'	0047'	0054'	0058'	103'	109'	1016'	1025'	1036'	1051'	200'	2011'	2028'	2040'	-	-	-	-	-	-	-	-
7/8	0032'	0035'	0040'	0046'	0050'	0054'	0059'	105'	1012'	1022'	1034'	1042'	1051'	202'	2015'	2031'	2051'	-	-	-	-	-	-
1	0028'	0031'	0035'	0040'	0043'	0047'	0051'	0057'	103'	1011'	1022'	1029'	1036'	1046'	1057'	2011'	2029'	2052'	-	-	-	-	-
1.1/8	0025'	0027'	0031'	0035'	0038'	0042'	0045'	0050'	0056'	103'	1012'	1018'	1025'	1033'	1043'	1055'	2011'	2031'	2059'	-	-	-	-
1.1/4	0022'	0025'	0028'	0032'	0034'	0037'	0041'	0045'	0050'	0057'	105'	1010'	1016'	1023'	1032'	1043'	1057'	2015'	2040'	-	-	-	-
1.3/8	0020'	0022'	0025'	0029'	0031'	0034'	0037'	0041'	0045'	0051'	0059'	108'	109'	1016'	1026'	1033'	1046'	202'	2024'	2038'	2056'	-	-
1.1/2	0018'	0021'	0023'	0026'	0029'	0031'	0034'	0037'	0042'	0047'	0054'	0058'	103'	109'	1016'	1025'	1036'	1051'	2011'	2028'	2040'	-	-
1.5/8	0017'	0019'	0021'	0024'	0026'	0029'	0031'	0034'	0038'	0043'	0049'	0053'	0058'	103'	1010'	1018'	1029'	1042'	200'	2012'	2026'	2044'	-
1.3/4	0016'	0018'	0020'	0023'	0024'	0026'	0029'	0032'	0035'	0040'	0046'	0049'	0054'	0059'	105'	1012'	1022'	1034'	1051'	202'	2015'	2031'	-
1.7/8	0015'	0016'	0018'	0021'	0023'	0025'	0027'	0030'	0033'	0037'	0043'	0046'	0050'	0055'	100'	107'	1016'	1028'	1043'	1053'	203'	2020'	-
2	-	0015'	0017'	0020'	0021'	0023'	0025'	0028'	0031'	0035'	0040'	0043'	0047'	0051'	0057'	103'	1011'	1022'	1036'	1046'	1057'	2011'	2029'
2.1/4	-	-	0015'	0018'	0019'	0021'	0022'	0025'	0027'	0031'	0035'	0038'	0042'	0045'	0050'	0056'	103'	1012'	1025'	1033'	1043'	1055'	2011'
2.1/2	-	-	-	0016'	0017'	0018'	0020'	0022'	0025'	0028'	0032'	0034'	0037'	0041'	0045'	0050'	0057'	105'	1016'	1024'	1032'	1043'	1057'	
2.3/4	-	-	-	-	0015'	0017'	0018'	0020'	0022'	0025'	0029'	0031'	0034'	0037'	0041'	0045'	0051'	0059'	109'	1016'	1028'	1033'	1046'	
3	-	-	-	-	-	0015'	0017'	0018'	0021'	0023'	0026'	0029'	0031'	0034'	0037'	0042'	0047'	0054'	103'	109'	1016'	1025'	1036'	
3.1/2	-	-	-	-	-	0013'	0014'	0016'	0018'	0020'	0023'	0024'	0026'	0029'	0032'	0035'	0040'	0046'	0054'	0059'	105'	1012'	1022'	
4	-	-	-	-	-	0011'	0012'	0014'	0015'	0017'	0020'	0021'	0023'	0025'	0028'	0031'	0035'	0040'	0047'	0051'	0057'	103'	1011'	
4.1/2	-	-	-	-	-	-	0011'	0012'	0014'	0015'	0018'	0019'	0021'	0022'	0025'	0027'	0031'	0036'	0042'	0045'	0050'	0056'	103'	
5	-	-	-	-	-	-	0010'	0011'	0012'	0014'	0016'	0017'	0018'	0020'	0022'	0025'	0028'	0032'	0037'	0041'	0045'	0050'	0057'	
5.1/2	-	-	-	-	-	-	009'	0010'	0011'	0013'	0014'	0015'	0017'	0018'	0020'	0022'	0025'	0029'	0034'	0037'	0041'	0045'	0051'	
6	-	-	-	-	-	-	008'	009'	0010'	0012'	0013'	0014'	0015'	0017'	0018'	0021'	0023'	0027'	0031'	0034'	0037'	0042'	0047'	
6.1/2	-	-	-	-	-	-	-	008'	009'	0011'	0012'	0013'	0014'	0015'	0017'	0019'	0021'	0024'	0029'	0031'	0034'	0038'	0043'	
7	-	-	-	-	-	-	-	-	009'	0010'	0011'	0012'	0013'	0014'	0016'	0018'	0020'	0023'	0027'	0029'	0032'	0035'	0040'	
7.1/2	-	-	-	-	-	-	-	-	008'	009'	0011'	0011'	0012'	0013'	0015'	0016'	0018'	0021'	0025'	0027'	0030'	0033'	0037'	
8	-	-	-	-	-	-	-	-	-	009'	0010'	0011'	0011'	0013'	0014'	0015'	0017'	0020'	0023'	0025'	0028'	0031'	0035'	
8.1/2	-	-	-	-	-	-	-	-	-	008'	009'	0010'	0011'	0012'	0013'	0014'	0016'	0019'	0022'	0024'	0026'	0029'	0033'	
9	-	-	-	-	-	-	-	-	-	-	009'	009'	0010'	0011'	0012'	0014'	0015'	0018'	0021'	0022'	0025'	0027'	0031'	
9.1/2	-	-	-	-	-	-	-	-	-	-	008'	009'	0010'	0011'	0012'	0013'	0015'	0017'	0019'	0021'	0023'	0026'	0029'	
10	-	-	-	-	-	-	-	-	-	-	-	008'	009'	0010'	0011'	0012'	0014'	0016'	0018'	0020'	0022'	0025'	0028'	
10.1/2	-	-	-	-	-	-	-	-	-	-	-	-	009'	0010'	0011'	0012'	0013'	0015'	0018'	0019'	0021'	0023'	0027'	
11	-	-	-	-	-	-	-	-	-	-	-	-	008'	009'	0010'	0011'	0013'	0014'	0017'	0018'	0020'	0022'	0025'	
11.1/2	-	-	-	-	-	-	-	-	-	-	-	-	-	0°9'	0°10'	0°11'	0°12'	0014'	0016'	0017'	0019'	0021'	0024'	
12	-	-	-	-	-	-	-	-	-	-	-	-	-	008'	009'	0010'	0011'	0013'	0015'	0017'	0018'	0021'	0023'	

Helix angles based on pitch diameters.

OUTSIDE DIAMETER M/M	PITCH M/M																		
	0.5	0.6	0.7	0.75	0.8	0.9	1.0	1.25	1.5	1.75	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0
3	3°24'	4°14'	5° 0'	5°26'	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3.5	2°53'	3°31'	4°11'	4°32'	4°53'	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	2°29'	3° 2'	3°36'	3°53'	4°22'	4°48'	-	-	-	-	-	-	-	-	-	-	-	-	-
4.5	2°11'	2°40'	3° 9'	3°24'	4°11'	4°24'	5°25'	-	-	-	-	-	-	-	-	-	-	-	-
5	1°57'	2°22'	2°49'	3° 2'	3°18'	3°43'	5° 9'	5°35'	-	-	-	-	-	-	-	-	-	-	-
5.5	1°46'	2° 9'	2°32'	2°45'	2°56'	3°20'	3°45'	4°57'	6° 1'	-	-	-	-	-	-	-	-	-	-
6	1°37'	1°57'	2°17'	2°28'	2°40'	3° 2'	3°24'	4°23'	5°26'	6°31'	-	-	-	-	-	-	-	-	-
7	1°22'	1°39'	1°57'	2° 6'	2°16'	2°33'	2°51'	3°41'	4°32'	5°26'	-	-	-	-	-	-	-	-	-
8	1°11'	1°26'	1°42'	1°50'	1°57'	2°14'	2°30'	3°10'	3°52'	4°32'	-	-	-	-	-	-	-	-	-
9	1° 3'	1°16'	1°30'	1°38'	1°46'	1°57'	2°11'	2°48'	3°24'	4° 3'	-	-	-	-	-	-	-	-	-
10	0°57'	1° 8'	1°20'	1°27'	1°34'	1°47'	1°57'	2°29'	3° 2'	3°36'	4°11'	5°26'	-	-	-	-	-	-	-
11	0°51'	1° 2'	1°14'	1°21'	1°26'	1°37'	1°46'	2°18'	2°40'	3°14'	-	-	-	-	-	-	-	-	-
12	0°47'	0°56'	1° 5'	1°10'	1°16'	1°26'	1°37'	2° 3'	2°29'	2°56'	3°24'	4°18'	5°26'	-	-	-	-	-	-
14	0°40'	0°48'	0°56'	1° 0'	1° 5'	1°12'	1°22'	1°44'	2° 6'	2°29'	2°52'	3°41'	4°32'	5°26'	-	-	-	-	-
16	0°35'	0°42'	0°50'	0°54'	0°57'	1° 5'	1°12'	1°30'	1°49'	2° 8'	2°29'	3°10'	3°53'	4°39'	5°26'	-	-	-	-
18	0°29'	0°37'	0°44'	0°47'	0°50'	0°57'	1° 3'	1°19'	1°37'	1°53'	2°11'	2°47'	3°24'	4° 3'	4°40'	5°26'	-	-	-
20	0°28'	0°34'	0°39'	0°42'	0°45'	0°51'	0°57'	1°11'	1°26'	1°40'	1°57'	2°29'	3° 2'	3°36'	4°10'	4°48'	5°26'	-	-
22	0°25'	0°30'	0°36'	0°39'	0°43'	0°46'	0°51'	1° 5'	1°18'	1°30'	1°46'	2°12'	2°44'	3°14'	3°45'	4°17'	4°51'	5°26'	-
24	-	0°28'	0°33'	0°35'	0°37'	0°42'	0°47'	0°59'	1°11'	1°23'	1°36'	2° 1'	2°28'	2°57'	3°24'	3°55'	4°25'	4°53'	5°26'
27	-	-	0°29'	0°31'	0°33'	0°38'	0°43'	0°52'	1° 3'	1°14'	1°25'	1°48'	2°12'	2°35'	2°59'	3°24'	3°50'	4°17'	4°43'
30	-	-	-	0°28'	0°30'	0°34'	0°38'	0°47'	0°57'	1° 7'	1°17'	1°37'	1°58'	2°18'	2°39'	3° 2'	3°24'	3°47'	4°11'
33	-	-	-	-	-	-	0°34'	0°43'	0°51'	1° 0'	1° 8'	1°27'	1°46'	2° 5'	2°24'	2°44'	3° 4'	3°26'	3°46'
39	-	-	-	-	-	-	0°28'	0°36'	0°44'	0°51'	0°58'	1°13'	1°28'	1°44'	2° 0'	2°16'	2°32'	2°50'	3° 7'
45	-	-	-	-	-	-	0°25'	0°31'	0°37'	0°43'	0°50'	1° 3'	1°16'	1°30'	1°43'	1°57'	2°10'	2°25'	2°40'
52	-	-	-	-	-	-	-	0°27'	0°32'	0°37'	0°43'	0°54'	1° 5'	1°16'	1°28'	1°41'	1°53'	2° 5'	2°14'
60	-	-	-	-	-	-	-	-	0°28'	0°33'	0°38'	0°47'	0°56'	1° 7'	1°16'	1°26'	1°36'	1°46'	1°57'
68	-	-	-	-	-	-	-	-	-	0°29'	0°33'	0°41'	0°50'	0°58'	1° 6'	1°15'	1°24'	1°34'	1°42'
76	-	-	-	-	-	-	-	-	-	-	0°29'	0°37'	0°46'	0°54'	1° 0'	1° 8'	1°16'	1°24'	1°32'
84	-	-	-	-	-	-	-	-	-	-	0°27'	0°29'	0°40'	0°47'	0°55'	1° 1'	1° 8'	1°15'	1°23'
90	-	-	-	-	-	-	-	-	-	-	0°25'	0°31'	0°37'	0°43'	0°50'	0°56'	1° 2'	1° 9'	1°15'
99	-	-	-	-	-	-	-	-	-	-	-	0°28'	0°34'	0°40'	0°46'	0°52'	0°57'	1° 3'	1° 9'
114	-	-	-	-	-	-	-	-	-	-	-	-	0°29'	0°34'	0°39'	0°44'	0°49'	0°55'	1° 0'
124	-	-	-	-	-	-	-	-	-	-	-	-	0°27'	0°31'	0°35'	0°39'	0°43'	0°48'	0°54'
130	-	-	-	-	-	-	0° 8'	0°11'	0°13'	0°15'	0°17'	0°21'	0°26'	0°30'	0°34'	0°39'	0°43'	0°48'	0°52'
140	-	-	-	-	-	-	-	0°10'	0°12'	0°14'	0°16'	0°20'	0°24'	0°28'	0°32'	0°36'	0°40'	0°44'	0°48'
150	-	-	-	-	-	-	-	0° 9'	0°11'	0°13'	0°15'	0°18'	0°22'	0°26'	0°30'	0°34'	0°37'	0°41'	0°45'
160	-	-	-	-	-	-	-	0° 9'	0°10'	0°12'	0°14'	0°17'	0°21'	0°24'	0°28'	0°31'	0°35'	0°39'	0°42'
170	-	-	-	-	-	-	-	0° 8'	0°10'	0°11'	0°13'	0°16'	0°20'	0°23'	0°26'	0°30'	0°32'	0°36'	0°40'
180	-	-	-	-	-	-	-	-	0° 9'	0°11'	0°12'	0°15'	0°18'	0°22'	0°25'	0°28'	0°31'	0°34'	0°37'
190	-	-	-	-	-	-	-	-	0° 9'	0°10'	0°12'	0°15'	0°18'	0°20'	0°23'	0°26'	0°29'	0°32'	0°35'
200	-	-	-	-	-	-	-	-	0° 8'	0°10'	0°11'	0°14'	0°17'	0°19'	0°22'	0°25'	0°28'	0°31'	0°34'
220	-	-	-	-	-	-	-	-	-	0° 9'	0°10'	0°13'	0°15'	0°18'	0°20'	0°23'	0°25'	0°28'	0°30'
240	-	-	-	-	-	-	-	-	-	0° 8'	0° 9'	0°12'	0°14'	0°16'	0°18'	0°21'	0°23'	0°26'	0°28'
260	-	-	-	-	-	-	-	-	-	-	0° 8'	0°11'	0°13'	0°15'	0°17'	0°19'	0°21'	0°24'	0°26'
280	-	-	-	-	-	-	-	-	-	-	-	0°10'	0°12'	0°14'	0°16'	0°18'	0°20'	0°22'	0°24'
300	-	-	-	-	-	-	-	-	-	-	-	0° 9'	0°11'	0°13'	0°15'	0°17'	0°18'	0°20'	0°22'

Oil Recommendations

Z

When studying the Operator's Manual of a Matrix Machine, it will be noticed that various types of coolant oils, lubricating oils, hydraulic oils and lubricating greases are recommended.

These recommendations are based on extensive research and the optimum results will be obtained if the actual oil/grease recommended is used. Obviously however, there will be occasions when the recommended brand will not be available, or it may be a policy of a firm to standardise on the products of a supplier whose manufacturers are not mentioned in our publications.

In the case of these circumstances prevailing, the specifications below will assist the user in selecting a suitable equivalent. The oils specified below are completely representative of all oils recommended for the whole range of Matrix Machines and therefore some will not be relevant to the actual machine supplied.

COOLANT OILS

ADFORMAL E.P.7

Neat Cutting Oil: A heavy viscosity sulphur chlorinated mineral oil containing sulphur, chlorine and fatty additives. In the manuals this is specified for thread grinding operations.

SPECIFIC GRAVITY	0.940
CLOSED FLASH POINT	345°F (174°C)
REDWOOD VISCOSITY @ 70°F (21°C)	1,250
@ 140°F(60°C)	150
KINEMATIC VISCOSITY @ 100°F (38°C)	110
POUR POINT	minus 5°F (minus20.5°C)

SUPPLIER: ALEXANDER DUCKHAM & COMPANY LIMITED

KEMCUT 300

Neat Cutting Oil: A medium viscosity sulphur chlorinated mineral oil containing sulphur and chlorine. Specified for thread grinding operations.

OPEN FLASH POINT..	375°F (190°C)
REDWOOD VISCOSITY @ 140°F (60°C)	75
KINEMATIC VISCOSITY @ 100°F (31°C)	47
POUR POINT	minus 10°F (minus 25.5°C)

SUPPLIER: ALEXANDER DUCKHAM & COMPANY LIMITED

FRAPOL MEDIUM T.G.'

Neat Cutting Oil: A medium viscosity mineral oil containing sulphur and fatty additives. Specified for thread grinding operations.

SPECIFIC GRAVITY	0.920
OPEN FLASH POINT	340°F (171°C)
REDWOOD VISCOSITY @ 70°F (21°C)	420

SUPPLIER: EDGAR VAUGHAN & COMPANY LIMITED

FRAPOL HEAVY T.G.'

Neat Cutting Oil: A heavy viscosity mineral oil containing sulphur and fatty additives. Specified for thread grinding operations.

SPECIFIC GRAVITY	0.935
OPEN FLASH POINT	360°F (182°C)
REDWOOD VISCOSITY @ 70°F (21°C)	93

SUPPLIER: EDGAR VAUGHAN & COMPANY LIMITED

SHELLCUT T.G.

Neat Cutting Oil: A moderately heavy dark-coloured mineral oil containing sulphur and fatty additives. Specified for thread grinding operations.

SPECIFIC GRAVITY	0.945
REDWOOD VISCOSITY @ 70°F (21°C)	650
@ 140°F(60°C)	95

MANUFACTURER: SHELL OIL COMPANY LIMITED

ILOCUT 482*

*In some manuals this may be referred to as ILOCUT T.G.20 which it supersedes.

Neat Cutting Oil: A medium viscosity mineral oil containing chlorine and fatty additives. Specified for thread grinding operations.

SPECIFIC GRAVITY	0.825
CLOSED FLASH POINT	340°F(171°C)
REDWOOD VISCOSITY @ 70°F (21°C)	220
@ 140°F(60°C)	54

MANUFACTURER: CASTROL LIMITED

ILOCUT 154*

*In some manuals this may be referred to as ILOCUT T.G. 40 which it supersedes.

Neat Cutting Oil: A heavy viscosity oil containing sulphur and fatty additives. Specified for thread grinding operations.

SPECIFIC GRAVITY	0.825
CLOSED FLASH POINT	370°F (188°C)
REDWOOD VISCOSITY @ 70°F (21°C)	290
@ 140°F(60°C)	66

MANUFACTURER: CASTROL LIMITED

TRANSCUT 50

This is a transparent soluble oil containing rust inhibitors. It is used at a dilution of 1 part of oil to 50 parts of water.

This oil is mainly used on Matrix No. 70 Ballscrew and Thread Grinding Machines.

KOOLMAX 81X

This oil is recommended for use on Thompson/Matrix Truform Grinding Machines.

Neat Cutting Oil: Light-coloured sulpho-chlorinated precision grinding oil. Mineral oil base containing sulphur, chlorine and fatty additives.

SPECIFIC GRAVITY	0.926
REDWOOD VISCOSITY @ 70°F (21°C)	286
@ 140°F(60°C)	60
OPEN FLASH POINT	340°F (171°C)
CLOSED FLASH POINT	320°F (160°C)

MANUFACTURER: METALWORKING LUBRICANTS LIMITED

HOUGHTO-GRIND 45

This coolant is recommended for general-purpose surface grinding on Thompson/Matrix Machines. This is a non-oily chemical grinding fluid, having a sodium nitrite base with rust inhibiting additives. It is used at a dilution of 100:1.

LUBRICATION SPECIFICATION

The following tables are intended as a guide to the lubricants which should be used on machines supplied by Coventry Gauge & Tool Company Limited. If the recommended lubricant is not available, great care should be taken in selecting a suitable equivalent.

APPLICATION	RECOMMENDED MOBIL OIL GRADE	CHARACTERISTICS	SAYBOLT UNIVERSAL VISCOSITY		POUR POINT	OPEN FLASH POINT	SPECIFIC GRAVITY
			at 100°F	at 210°F			
SPINDLE OIL (Zero Clearing Bearing)	VELOCITE No. 3	Oxidation and rust inhibitors and defoament	30/40	-	20°F	170°F	0.800
SPINDLE OIL	VELOCITE No. 6	Oxidation and rust inhibitors and defoament	55/85	35	25°F	290°F	0.850
HYDRAULIC AND SLIDEWAY OIL	VACUOLINE 1405	Oxidation and rust inhibitors and defoament plus 5% fixed oil and lubricity additions	145/175	43	15°F	385°F	0.875
HYDRAULIC OIL	D.T.E. LIGHT	Oxidation and rust inhibitors and defoament	145/170	43.5	20°F	395°F	0.870
GENERAL LUBRICATING OIL	VACTRA HEAVY MEDIUM	Oxidation and rust inhibitors and defoament plus lubricity additive	275/375	51.0	15°F	420°F	0.880
SLIDEWAY OIL	VACTRA No. 2	7½% Fixed Oil, Mild EP Additive, adhesive agent defoament and special compound	300/475	52	0	340°F	0.985
SPECIAL OIL FOR KOPP VARIATOR (MATRIX No. 2 MACHINE)	MOBIL FLUID No. 62	-	60/85	-	40°F	285°F	0.875
SPECIAL OIL FOR MAGNETIC SPEARATOR GEARBOX	MOBIL COMPOUND DD or COMPOUND BB	-	1200/1500	-	0	-	-
GEAR OIL	D.T.E. BB	-	80/1000	84	25°F	440°F	0.900