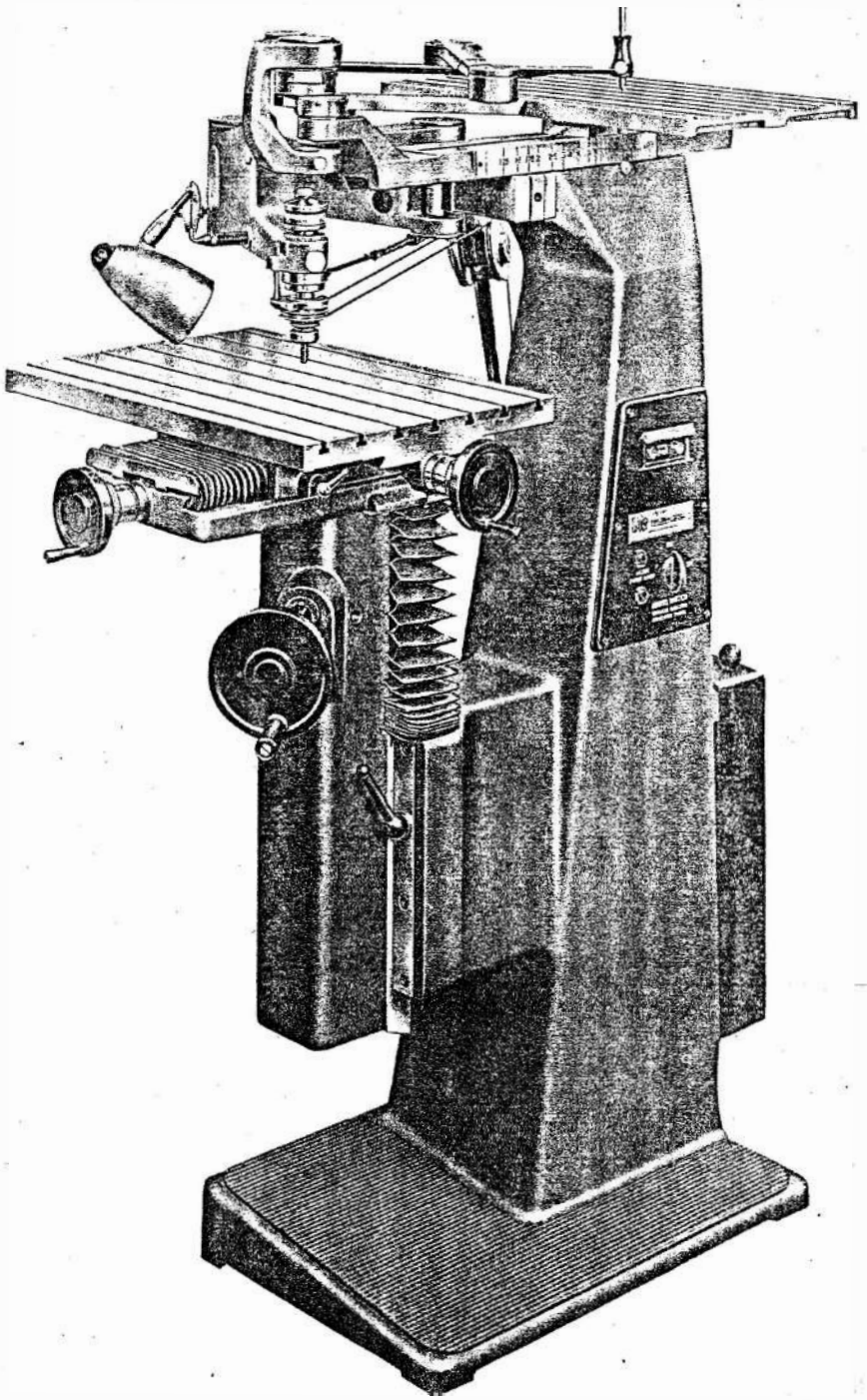
19 - 8

OPERATOR'S HANDBOOK

Price 10/6



MODEL K Mk.2 PANTOGRAPH ENGRAVING MACHINE

TAYLOR-® HOBSON

THE RANK ORGANISATION
RANK TAYLOR HOBSON DIVISION
Leicester · England
Telephone: Leicester 23801 Telex: 34533

Introduction

The pantograph machine is perhaps the most versatile machine tool of our day and is now widely used in many branches of industry. It is true to say that there is scarcely an article encountered in everyday life of which a process of its manufacture does not involve use of the pantograph machine. Lettering, moulds, dies, press tools, irregular shapes, can all be conveniently worked in a wide range of materials with precision and, perhaps most important of all, in most cases a considerable saving in time over conventional methods of producing the same article.

The Supplement section of this Handbook contains certain information on the Art of Engraving for lettering and designs. Also included is a brief description of profile milling with illustrations of the type of component that can be machined complete on the Model K Mk.2 Machine.

We have a specialist staff of consulting engineers who will be pleased to advise you on any aspect of engraving, forming and profile milling not covered in this Handbook.

CONTENTS

STANDARD EQUIPMENT provided with the K Mk.2 machine

110/12	Table Dogs and Bolts (2)	110/674	Adapter for taper shank cutters	116/42	Collet Spanner
110/15	Magnifying Glass			116/52	$\frac{13}{16}$-in A/F Open-ended Spanner
110/19	Oilstone	110/888	Style Collar	116/58	Set Hexagon Wrench Keys
110/120	Cutter Wrench	110/889	E.M. Style		$\frac{1}{16}$-in to $\frac{3}{8}$-in A/F
110/313	12-in Rule in Case	110/897	Spindle Drive Belt (2) (1 spare)	116/82	Adjustable Face Spanner ($\frac{3}{32}$-in pins)
110/895	Type 'L' Collet Spindle				
110/672	$\frac{1}{4}$-in Collet \ English	110/898	Flat Nylon Belt (Motor)	116/86	$\frac{1}{2}$-in UN Open-ended Spanner
110/673	$\frac{3}{8}$-in Collet / machine	110/11	Table Fence (5-in (127 mm) long) or	116/87	$\frac{1}{2}$-in UN Open-ended Spanner ($\frac{1}{8}$-in thick)
110/688	4 mm Collet \	110/908	Table Fence ($1\frac{1}{2}$-in (38 mm) long) (2)	116/88	Tommy Bar $\frac{5}{16}$-in diameter.
110/689	6 mm Collet \			117/7	Tool Box
110/690	8 mm Collet \ Metric	116/41	$\frac{1}{4}$-in UN/1BA Double-ended Wrench	19/8	Operator's Handbook
110/691	10 mm Collet \ machine			11/2	Filler Leaflet
110/673	$\frac{3}{8}$-in Collet /				Sample White Filler
(to hold 110/674)					

WORK CAPACITY

(Measurements made with the cutter at the centre of its sweep at all reductions)

Throat depth—worktable fully raised	$16\frac{1}{2}$-in (419 mm)
worktable fully lowered	$14\frac{1}{2}$-in (368 mm)
pantograph at 6:1, head extended, table raised	$19\frac{1}{2}$-in (495 mm)
Distance from spindle nose to worktable—maximum (worktable fully lowered)	$10\frac{1}{2}$-in (267 mm)
minimum (worktable fully raised)	Nil

CUTTER COVERAGE

(Pantograph set at 1:1)

Circle	Square	Rectangle
13-in (330 mm) dia.	12-in (305 mm)	9-in × 18-in (229 mm × 457 mm)

CUTTER SPEEDS - REV/MIN

3,000, 4,000, 5,000, 6,000, 9,000, 12,000, 15,000 and 18,000

CUTTERS

RTH taper shank Engraving Cutters
Parallel shank cutters up to $\frac{3}{8}$-in or 10 mm diameter

CUTTER FEED

Full screw feed of $\frac{1}{2}$-in (12,7 mm)
Combined lever and screw feed of 0·35-in (9 mm)

PANTOGRAPH REDUCTIONS

The pantograph can be adjusted to give reductions from 1:1 to 50:1. For reductions between 1:1 and 6:1 the bar scales are graduated in units of tenths of whole numbers, from 6:1 to 9:1 in quarters of whole numbers, from 9:1 to 10:1 in halves of whole numbers, from 10:1 to 20:1 in whole numbers and from 20:1 to 50:1 in steps of five. Intermediate reductions can be set using the formula on page 26.

WORK TABLE

Size 20-in × 14-in
(508 mm × 356 mm)

7 Tee Slots $\frac{3}{8}$-in × 20-in
(9,5 mm × 508 mm)
on $1\frac{3}{8}$-in (47,6 mm) pitch

Motion	Calibrated in	Travel	Each Graduation on Handwheel Scale
Vertical	English Metric	11-in 280 mm	0·001-in 0,02 mm
Transverse	English Metric	10-in 254 mm	0·002-in 0,05 mm
Longitudinal	English Metric	10-in 254 mm	0·002-in 0,05 mm

INSTALLATION

General

It is important that ropes used for lifting should be placed only around the main casting of the machine. On no account should ropes be put under the worktable assembly. Protect the paint work with soft cloth.

It is essential that the worktable lies approximately in the horizontal plane and if the floor is not level it may be necessary to put packing under one or more corners of the machine. The floor should be of solid construction and reasonably free from vibration.

Where possible the machine should be installed near to a window so that the operator faces the light. If a work light is to be provided, this should illuminate the work from behind and slightly above the cutter when viewed from the operating position. A low voltage lighting unit, available as an optional accessory, is described and illustrated on pages 20 and 21.

Electrical Connection

It is strongly recommended that a competent electrician should carry out the connection of the machine to the mains supply.

On machines wired for three-phase operation, check that the motor pulley rotates in a clockwise direction. This check must be made before the drive belts are fitted. If rotation is not clockwise, interchange any two of the three input connections.

The mains input cable should be in conduit wherever possible, the conduit lying parallel to the machine column and as close as possible to avoid interference with the machine drive. The cable entry at the back of the column is threaded $\frac{3}{4}$-in/16 t.p.i. to take conduit or cable gland.

50 & 60 c/s Supply (Except Canada)

The electrical circuit Fig. 1, consists of a rotary mains switch, push button starter (incorporating thermal overload protection and no-volt release) and electric motor.

Certain components of the lighting circuit are also included in the basic machine. These are: fuse(s) and fuse holder(s), two-pin socket, cable and snap connectors. On machines wired for operation on three-phase electrical supply two fuses are fitted, and on those for operation on single-phase supply one fuse is fitted. The two-pin socket is located at the top rear of the machine column and a length of two-core cable from it feeds down inside the column, terminating in snap connectors behind the control panel. For details of the Low Voltage Lighting Unit see page 20.

Machines are supplied with all internal wiring complete and approximately 6 ft (1,8 m) of input cable for connection to the mains power supply. Connection to the mains, which should be via a suitable isolator, must be made as follows:

Single-phase supply – Connect the RED lead to LINE, BLACK lead to NEUTRAL and the GREEN lead to EARTH.

Three-phase supply – Connect the RED, WHITE and BLUE leads to the MAINS and the GREEN lead to EARTH.

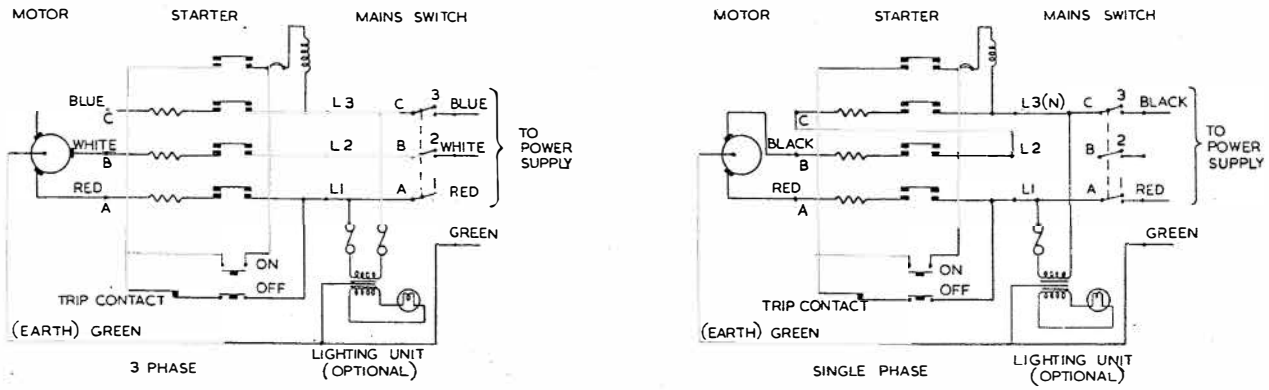
60 c/s Supply (Canada Only)

Fig. 1A shows the correct wiring for single or three-phase supplies.

The electrical circuit consists of a push button starter (incorporating thermal overload protection and no-volt release) and electric motor. The motor is wired to the starter but connection of the starter to the mains must be made via an isolator of approved design.

To connect the mains cable to the starter, remove the Control Panel from the front of the column (6 screws) and take off the starter front cover (2 captive screws). Pass the cable through the cable entry in the column, through the rubber bush in the top of the starter case and make connections as shown in Fig. 1A. The earth wire should be connected to the earth screw on top of the starter case. Whilst the front cover is off the starter, take care not to disturb the overload trip adjustment which has been set to suit the motor current rating.

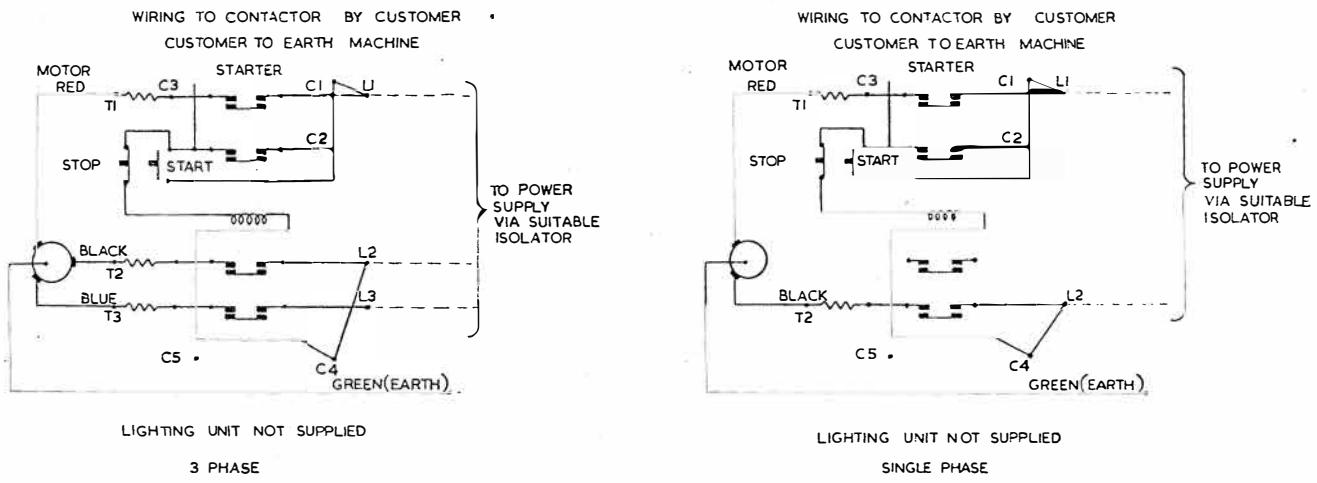
WIRING DIAGRAMS



50 AND 60 C/S (EXCEPT CANADA)

Fig. 1

WIRING DIAGRAMS



60 C/S (CANADA ONLY)

Fig. 1A

ERECTION

General

Tools necessary for the erection of the machine are provided as part of the standard equipment.

Transit grease is applied to all bright metal parts and should be wiped off prior to erection. The grease contains lubricating properties and only excess amounts need therefore be removed.

Motor/Jockey Pulley Assembly

For transit purposes the motor is held against movement by a wooden packing piece. Support the motor by holding the belt change lever and remove the packing piece by a direct pull. Gently lower the motor until it rests against the inside of the column.

Cutter Frame and Link

Clean off all transit grease where necessary and secure the link pivot post to the vee at the top of the machine column by the two $\frac{5}{16}$-in UNC screws, which are left in the column for transit purposes. The upper hole in the pivot post is reamed to a size which will just accept the screw thus ensuring correct location.

With the cutter frame and link correctly re-assembled its accuracy of movement parallel to the worktable should be to limits which are set at the factory. Using a dial indicator attached to the cutter frame in the region of the spindle sleeve, parallelism checked over an 8-in (200 mm) square should be within 0·003-in (0,075 mm). If a dial indicator is not available the check can be made using a dome-ended rod and feeler gauges.

The Pantograph (see Fig. 2)

The link spacer, pin and nut for the cutter frame bearing, which have been removed for transit will be found in a linen bag attached to the pantograph.

Insert the pantograph head bar into the head bar slider body, with the graduations 2:1 to 50:1 on the same side as the bar clamp screw, and slide the bar to the 1:1 position. Lightly clamp the bar. Set the cutter frame bar and style bar also at 1:1 and lightly clamp. Remove cover cap of cutter frame bearing assembly. Assemble the link spacer (small diameter uppermost) and the link pin and fit the nut, tightening the nut securely with the adjustable face spanner provided.

Check that the pantograph moves freely at all settings between 1:1 and 50:1.

Re-fit the cutter frame bearing cover cap.

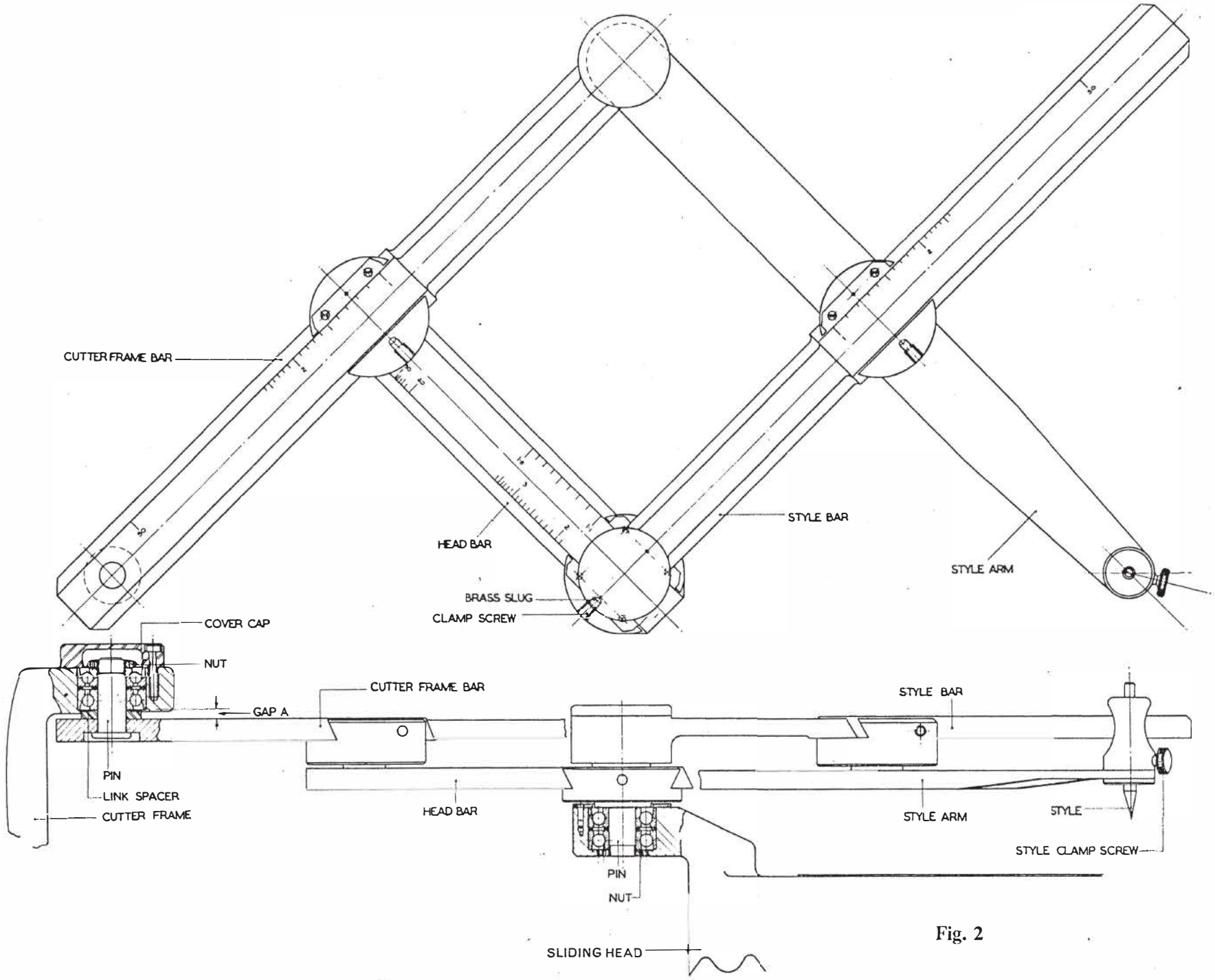

CUTTER FRAME BAR
HEAD BAR
STYLE BAR
STYLE ARM
BRASS SLUG
CLAMP SCREW
COVER CAP
NUT
GAP A
CUTTER FRAME BAR
STYLE BAR
PIN
LINK SPACER
CUTTER FRAME
HEAD BAR
STYLE ARM
STYLE
STYLE CLAMP SCREW
PIN
NUT
SLIDING HEAD

Fig. 2

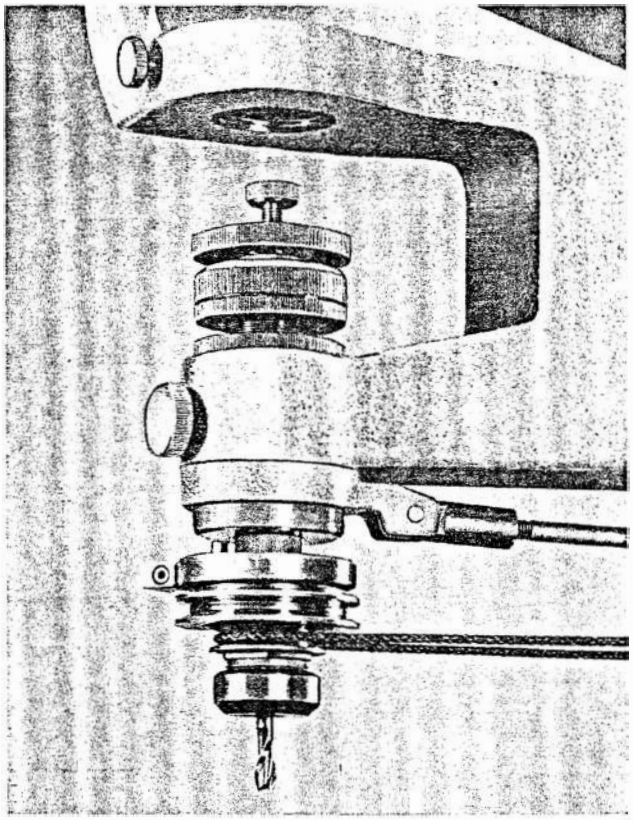


Fig. 3

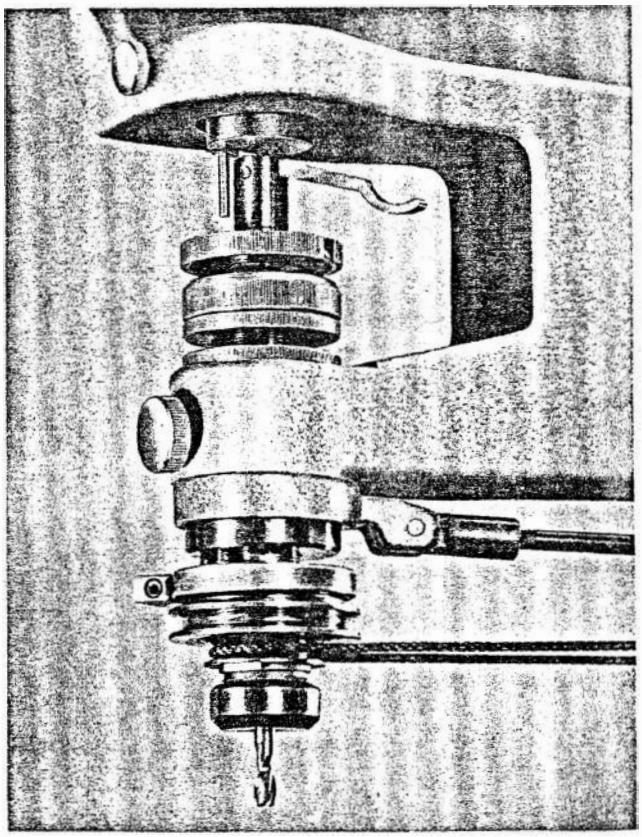


Fig. 4

Spindle and Feed Assembly (Figs. 3, 4 and 5)

The spindle feed can be assembled either as a screw feed (Fig. 3) giving a depth of feed of $\frac{1}{2}$-in (12,7 mm), or as a combined lever and screw feed unit (Fig. 4) giving a lever feed of approximately 0·15-in (4 mm) plus up to 0·2-in (5 mm) of screw feed.

For deliveries in the United Kingdom the spindle and feed assembly are left in position in the cutter frame, whilst for overseas deliveries they are removed and packed separately.

All moving parts, i.e., the spindle quill, feed screw thread and the mating faces of the feed nut and thrust ring, should be lubricated on assembly, thereafter at regular intervals (see Maintenance, page 13).

Assembling the Screw Feed (Fig. 5)

The spindle sleeve (1), which retains the stay rod swivel (2) on the cutter frame (3), is clamped by the ring (5) and is left in the cutter frame for transit purposes.

Remove the end cap from the spindle quill and assemble the feed screw (8) in its place, screwing down tightly. (The end cap should be retained for use when the spindle is returned for reconditioning).

Fit the clamp collar (16) to the quill shoulder.

Insert the spindle into the sleeve (1), locating the torque pin (17) in the slot in the cutter frame, and *lightly* clamp the spindle by the screw (4) to retain it in the sleeve.

Fit the circlip (18) to the torque pin and the spring (23) to the pins on the clamp collar and cutter frame. Release the screw (4) and check that the spindle slides smoothly up and down in its sleeve, with and against the pressure of the spring.

The clamp screw (4) is normally used only for clamping accessory equipment in the sleeve and should be left loose when the spindle is in use. The spring (23) should be removed when the screw feed is fully assembled but must be in position when either the lever feed or forming feed (page 19) is used.

Assemble the feed nut (9) to the feed screw (left-hand thread). Fit the clamp ring (6) and thrust ring (7) to the sleeve, screw the thrust ring down as far as possible then take back one full turn. Lock the thrust ring by the clamp ring.

Place the fibre washer (15) and spring washer (14) over the feed nut and fit the locknut (13) screwing it down into light engagement with the spring washer. Assemble the feed ring (10) to the feed nut, and screw down to the locknut (13). Lock the nut and feed ring tightly together using the spanner (116/87) provided.

Rotate the feed ring clockwise and observe that the spindle feeds down smoothly. If adjustment of the feed screw friction is required, release the locknut (13) and unscrew the feed ring approximately half a turn. Adjust the position of the locknut, rotating clockwise to increase the friction or anti-clockwise to reduce it, and screw the feed ring down to the nut. Lock tightly together.

Finally, pass the stop screw (11) through the feed ring and screw it into the top of the feed screw. The stop screw is split to give a friction fit to prevent movement from the stop setting by vibration.

Assembling the Lever Feed (Fig. 5)

Fully retract the spindle and remove the stop screw (11) and the feed ring (10). Unscrew the locknut (13) until there is a gap of approximately 0·15-in (4 mm) between the nut and the spring washer (14).

Assemble the thrust plug (20), stop pin (19) downwards, to the cutter frame and screw in the clamp screw (12) enough to retain the plug but permitting it to rotate freely.

By pushing downwards on the spindle pulley the lever feed ring (22) can be assembled to the feed nut (9) and screwed down until it abuts against the locknut (13). Rotate the feed ring (22) to bring the lever (21) to the most convenient operating position and lock firmly by the locknut.

Operate the lever and check that it locks down in the slot in the feed ring. Rotate the feed ring and observe that the spindle feeds down smoothly in its sleeve. Adjustment of feed screw friction (which is not applied until the lever is down) is by means of the thrust ring (7). Unlock the clamp ring (6) and adjust the thrust ring, rotating anti-clockwise to increase friction or clockwise to reduce it. Re-lock the clamp ring.

Rotate the thrust plug, to set the stop pin for the required amount of screw feed, and clamp by the screw (12).

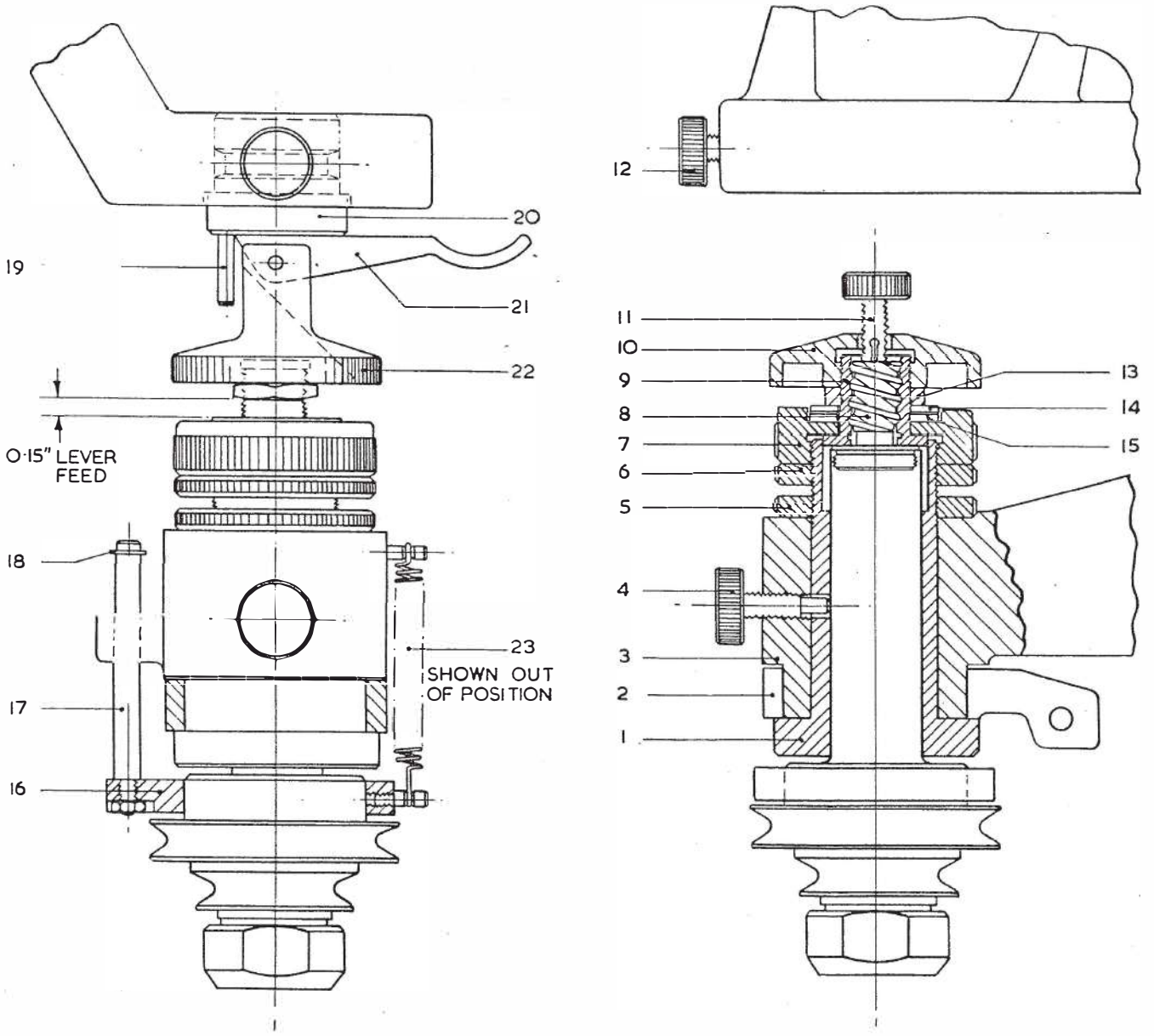


Fig. 5

The Rear Drive Arm/Stay Rod Unit (Fig. 6)

The pivot shaft is left in the drive arm pivot for transit. Unlock the hexagon socket screw and push out the pivot shaft. Locate the drive arm pivot on the column bracket, with the idler pulleys towards the drive belt safety cover, and insert the pivot shaft. Re-tighten the locking screw.

The upper idler pulley assembly, complete with stay rod, is mounted on the top of the rear drive arm. The threaded end of the stay rod is screwed into the stay rod swivel on the cutter frame. Before fitting the stay rod place the endless cotton belt over the pulleys of the rear drive arm.

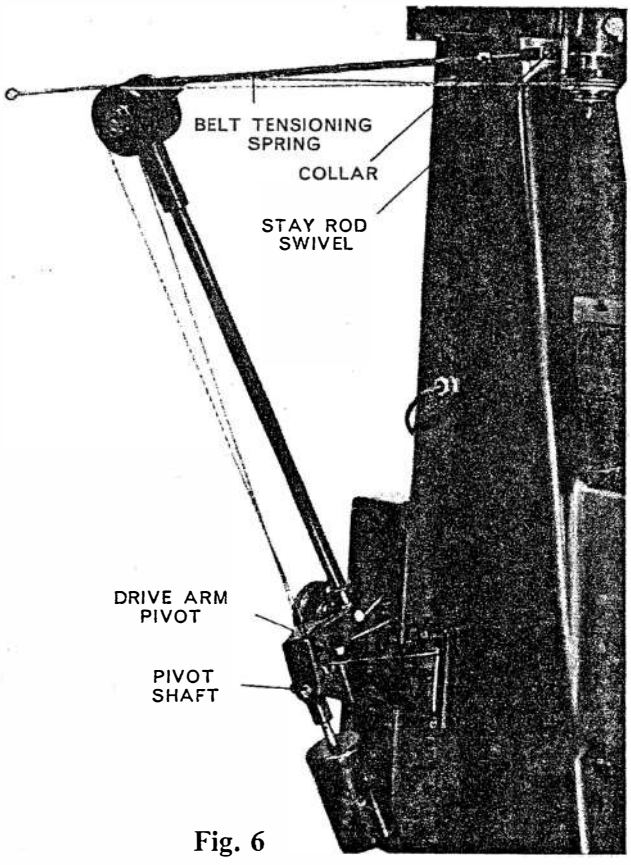


Fig. 6

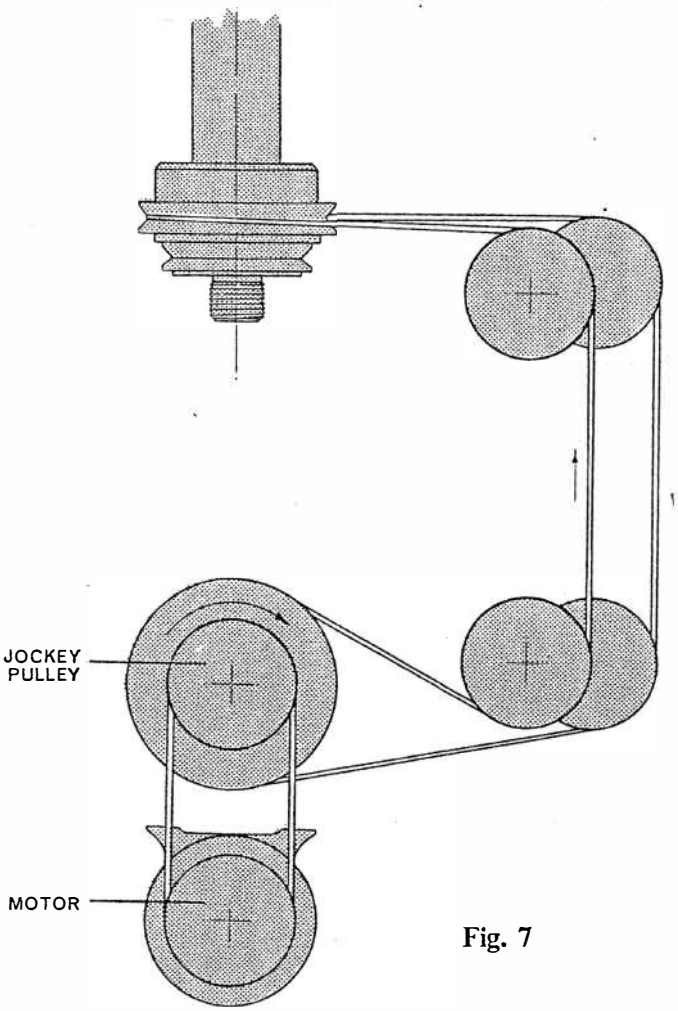


Fig. 7

The Drive Belts

The correct arrangement of the drive belts is shown diagrammatically in Fig. 7.

The endless cotton spindle drive belt should be fitted before the motor belt. A belt label, a facsimile of which is shown opposite, is located inside the safety cover, and shows how the belts are fitted to obtain a given spindle speed. Fit the belt to the appropriate step of the spindle pulley, pass it over the upper idler pulleys, under the lower idler pulleys and on to the appropriate step of the jockey pulley.

To tension the spindle belt, slacken the screw in the spring retaining collar on the stay rod, slide the collar back to increase the spring tension and re-tighten the collar screw.

The motor is mounted on a hinged bracket below the jockey pulley spindle and the motor belt is tensioned simply by the weight of the motor.

To fit the belt, lift the motor by pulling outwards on the lever provided, pass the belt over both the motor and jockey pulleys locating it in the appropriate step, and lower the motor to take up the slack.

The Copyholder

Place the copyholder bolt (1, Fig. 8) in the Tee-slot of the sliding head and fit the clamp ring (2) over the bolt, locating on the square shoulder. Position the copyholder slide plate (3) over the copyholder bolt and clamp ring, with the two pre-set stop screws away from the operator, and locate the tenons in the Tee-slot. Fit the copyholder to the slide plate, with the stop faces on the under edge of the copyholder on the same side as the two pre-set stop screws, and engage the threads of the copyholder and bolt by rotating the clamp ring.

To set the copyholder for the required reduction bring the index line on the copyholder slide plate coincident with the appropriate reduction figure on the head scale and clamp the copyholder, tightening the clamp ring (2) by use of the tommy bar provided.

It will be seen that the copyholder can be set parallel to, or square to, the slots in the worktable by engaging one or the other of the pre-set stop screws.

To remove the copyholder it is only necessary to slacken the copyholder bolt after which the copyholder together with the slide plate, clamp ring and bolt can be slid out of the Tee-slot.

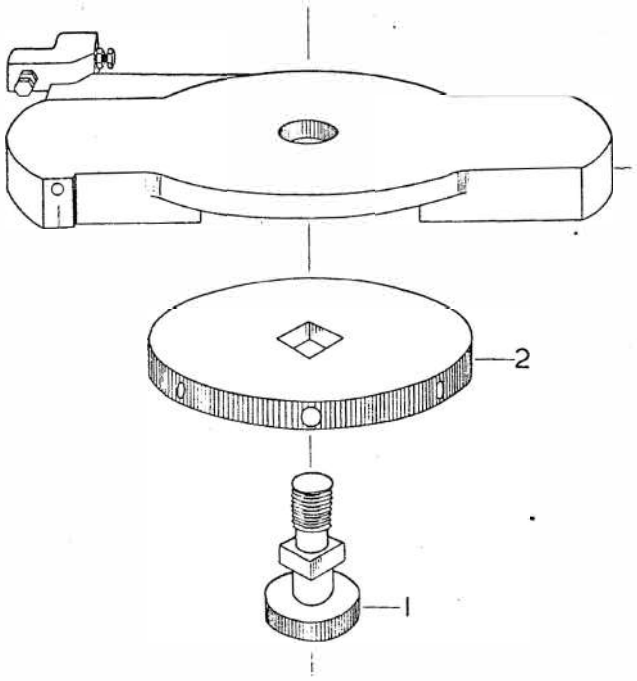
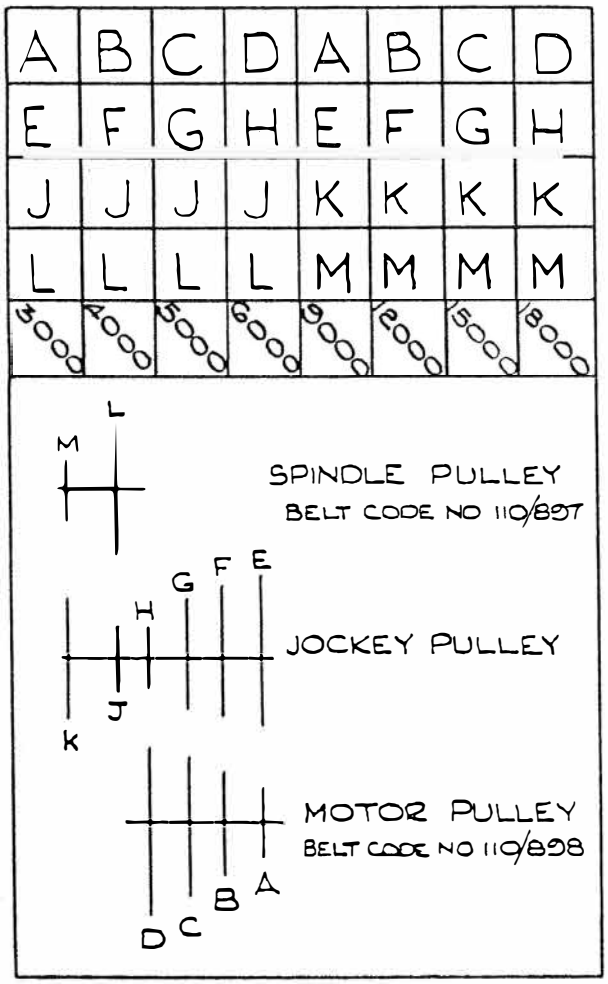


Fig. 8



Service Instructions

Model K Mk. 2 Engraving Machine is designed to have a long and trouble-free life, and any appreciable amount of service work is therefore not anticipated.

It is strongly recommended that any service operations (e.g., replacing lead screws and nuts, thrust races, etc.) should be carried out only by RTH or their agents. Should this prove impossible the work should be entrusted to a competent engineer who should use parts obtain from RTH and work to their instructions.

In the case of failure of the Spindle, damage to t Cutter Frame and Link or the Pantograph, the u should be returned to RTH (or local agent). It will appreciated that the rebuilding of these units entails t use of specialized equipment.

SERVICE ITEMS AND SPARES

Name	Quantity per Assembly	Code No.
Clamp Screw (Pantograph slider bodies)	3	20/2632
Brass Slug (Pantograph slider bodies)	3	02606
Nut (vertical slide lead screw)	1	02592
Nut (table lead screw)	1	02634
Nut (saddle lead screw)	1	02639
Handwheel (vertical slide)	1	02588
Handwheel (table and saddle)	2	02640
Slideway Cover (vertical slide)	1	02589
Slideway Cover (saddle slide)	2	02631
Head Clamp Bolt (Sliding Head)	1	20/2704
Copyholder Bolt	1	02722
Lead Screw and Nut (vertical slide)	1	K02591
Lead Screw and Nut (table slide)	1	K02633
Lead Screw and Nut (saddle slide)	1	K02638
Feed screw and Nut (spindle feed)	1	K02708

Name	Quantity per Assembly	Code No.
Bearings (Jockey Pulley shaft)	2	640/5
Bearings (Rear Drive Arm idler pulleys)	8	640/6
Milling Plug (Milling and Forming Attachment)	1	02719
Forming Stylus – 0·09-in (2,3 mm) tip radius	1	02720
Forming Stylus – 0·15-in (3,8 mm) tip radius	1	02721
Feed Screw (Forming Attachment)	1	02744
Feed Nut (Forming Attachment)	1	02745
½ A Fuse (Lighting Unit)	2*	120/4
12 V, 20 W Bulb (Lighting Unit)	1	120/29
Diamond Tip (Diamond Marking Tool)	1	02743

* Only one required on machines operating on single-phase electrical supply.

Code Numbers of Accessories

Milling and Forming Attachment	110/903
Former Blank	110/900
Diamond Marking Tool	110/904
Style and Rollers	110/905
Low Voltage Lighting Unit	110/906-S
Type 'K' Spindle (for taper shank cutters)	110/894
Machine Vice	110/17
Dividing Head	110/79-S
Resistance Etcher	110/170-
Single 'Javelin' Etcher	110/184-
Circular Table	110/706-
Tee Bolt ⅜-in diameter × 2½-in long, Nut and Washer	110/788
Collets for Type 'L' Spindle: ⅛-in	110/670
³⁄₁₆-in	110/671

MAINTENANCE

The following maintenance operations can be carried out by the machine operator. Tools required for any adjustments which have to be carried out are provided with the machine.

Lubrication

General Each week lubricate all slideways, lead screws and gears with medium grade machine oil. The slideway covers can be raised sufficiently to permit oiling of the parts mentioned.

Apply a little oil to all pivoting members of the rear drive arm to maintain free movement. All pulley bearings are packed with grease and should require no attention for a considerable period of time.

The Engraving Spindle and Feed Assembly

The spindle should be removed each week and a light film of grease applied to the quill, the feed screw and the mating faces of the feed nut and thrust ring. To remove the spindle, see below. The procedure for dismantling the feed assembly, for lubrication of the parts mentioned, is the reverse of the erection instructions given on page 8.

Recommended Grease: Molytone 320—obtainable direct from RTH (Code No. 6103/14420) or from the manufacturers, Rocol Ltd., Rocol House, Swillington, Leeds, England.

Note: The spindle is packed on assembly with the right amount and quality of grease suitable for high speed bearings, and will have considerable life without replenishment. It is recommended that should replenishment be required the spindle should be returned to RTH Service Department.

The Pantograph

A light film of oil applied to the machined sections of the pantograph bars will prevent corrosion and give easy setting of reductions. All pantograph joints are fitted with ball bearings packed with grease, requiring no attention.

The Cutter Frame and Link

All pivot points of the cutter frame and link assembly are fitted with roller bearings packed with grease and require no attention.

Removal of the Spindle

The elements of the spindle feed assembly to which the spindle is joined are shown in Fig. 5 on page 9. Removal of the spindle by the following procedure leaves the feed assembly still in position.

Remove the drive belt from the spindle pulley. Take out the stop screw (11). Remove the circlip (18) from the torque pin (17) and the spring (23) from the clamp collar (16).

Rotate the feed ring (10) clockwise until the feed screw (8) becomes detached from the feed nut (9) and the spindle, complete with the feed screw and clamp collar, can be withdrawn from the sleeve.

The feed screw (8) and the feed nut (9) are paired in manufacture and should always be used together. If more than one spindle is used with a particular feed assembly the feed screw must be transferred from one spindle quill to the other. The clamp collar (16) must also be transferred.

Note: The feed screw should be retained by the customer when a spindle is returned for reconditioning.

To replace the spindle, locate the spindle quill in the sleeve (1) and the torque pin (17) in the cutter frame (3). Engage the threads of the feed screw (8) and nut (9) by rotating the feed ring (10) anti-clockwise, and retract the spindle as far as possible.

Re-fit the circlip (18), spring (23) and the stop screw (11). Replace the drive belt on the spindle pulley.

For those wishing to remove the feed assembly the procedure is the reverse of the erection instructions given on page 8.

Handwheel Thimbles

If the graduated handwheel thimbles become stiff to turn this will undoubtedly be due to the ingress of dirt or cutting lubricant between the mating faces. The thimbles should be removed and cleaned, and lightly greased on the inside faces before replacement.

To remove the saddle and table thimbles, take off the handwheels by a direct pull and then remove the circlip retaining the thimble on the lead screw shaft. The thimble can now be withdrawn. The vertical lead screw handwheel is retained by a straight 'Sel-lok' pin which must be knocked out before the handwheel, circlip and thimble can be removed.

Cutter Frame and Link Bearings

If end play develops in the bearings of the cutter frame and link, slacken the locknut on the top cover cap of each bearing and adjust the hexagon socket set screw to take up the play. Do not overtighten the locknuts.

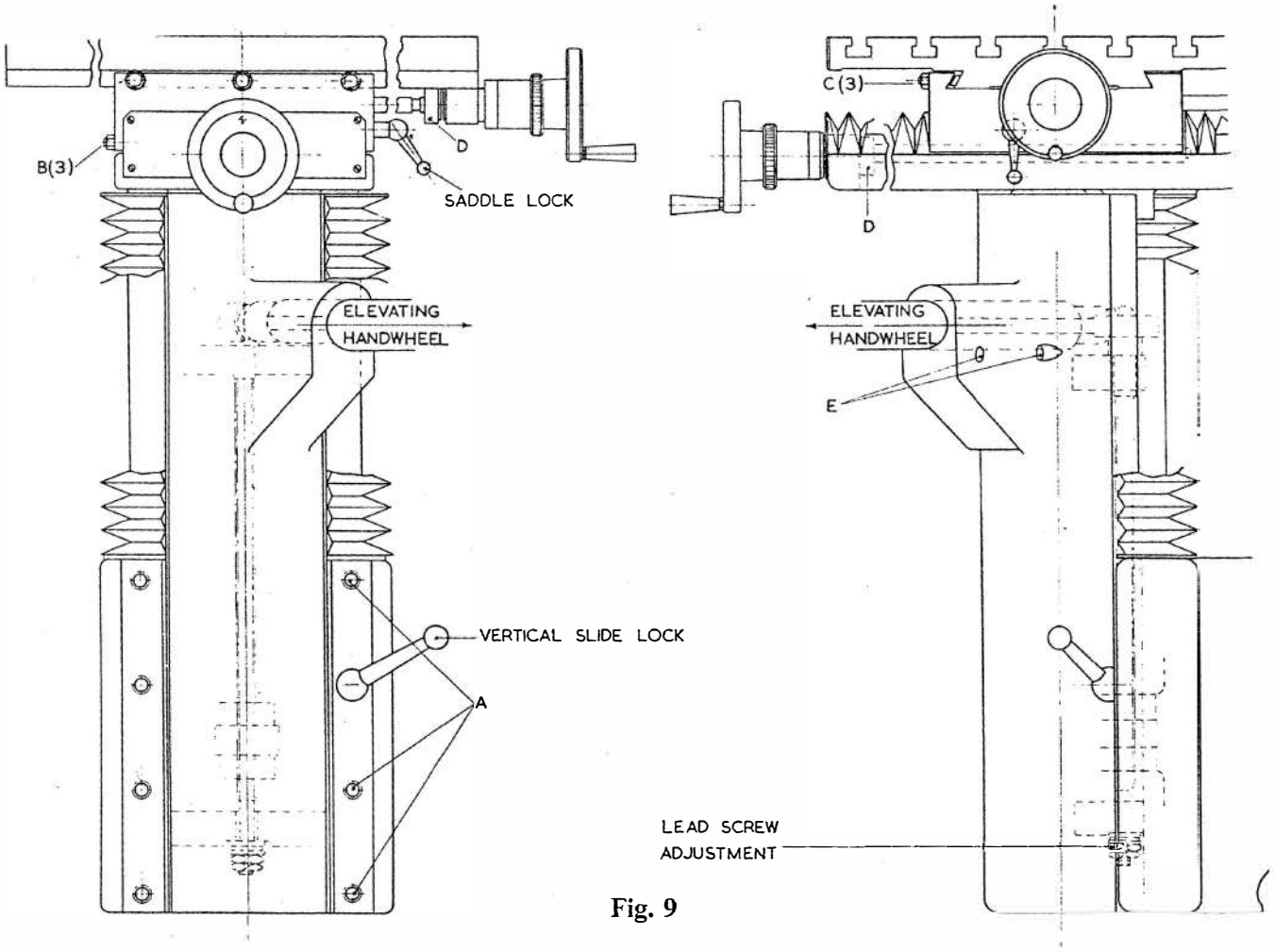


Fig. 9

Adjustment of Slides

After considerable use, the slides which carry the worktable may require adjustment. It is a simple matter to adjust them.

VERTICAL SLIDE: Lightly tighten the three screws A, Fig. 9, to take out any slack but leaving the slide still reasonably free to move by the handwheel.

SADDLE SLIDE: Slacken the locknuts on the three screws B, Fig. 9, and adjust the screws equally until the saddle moves easily, but not too freely, throughout its full movement. Hold the screws against rotation by the wrench key whilst re-tightening the locknuts.

TABLE SLIDE: Adjust as for saddle slide by means of the three screws C, Fig. 9.

Correcting Slide Screw End Play

SADDLE AND TABLE: To remove end play in the saddle and table lead screws, slacken the hexagon socket screw in the collar D, Fig. 9, push the lead screw forward, pull the collar back towards the lead screw bush and re-tighten the hexagon socket screw. To gain access to the saddle lead screw collar, wind the table in towards the column and detach the protective cover at the handwheel end of the slide (3 screws and nuts).

With end play taken up, a small amount of backlash will still be evident. This is allowed by movement of the lead screw nut in its forked bracket and does not immediately indicate wear between the nut and screw.

VERTICAL SLIDE: To remove end play in the lead screw, lower the table until the bottom of the lead screw is visible below the worktable support bracket (see Fig 9). Unlock the lower nut, adjust the upper nut to just take out the end play, and re-tighten the lower nut.

To remove end play in the handwheel tube assembly,

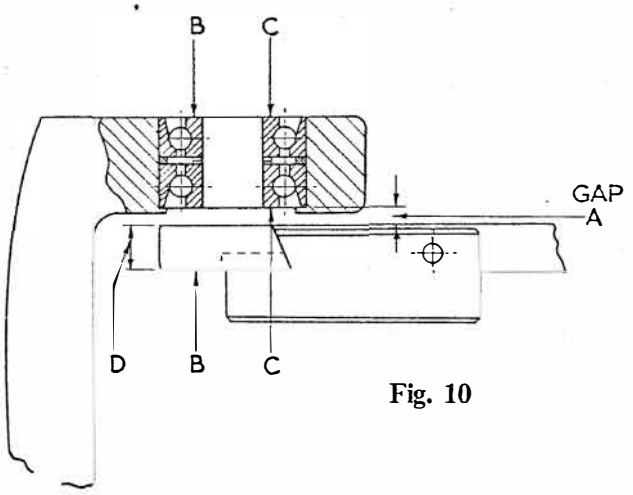


Fig. 10

remove the handwheel by knocking out the 'Sel-lok' pin, remove the circlip and withdraw the thimble. Slacken the hexagon socket screw in the split collar, draw the spindle back and push the collar forward, re-tightening the collar screw. Re-fit thimble, circlip and handwheel.

Backlash between the gears can be removed by slackening the two hexagon socket cap screws E, Fig. 9, and rotating the handwheel tube.

Removal of the Pantograph

The pantograph is designed to have long life without attention. Should the need for reconditioning arise necessitating its removal and return to RTH Service Department the following procedure should be adopted. The components relevant to the removal of the pantograph are shown drawn in section in Fig. 2.

Disengage the cutter frame bar from the cutter frame by removing the cover cap, undoing the nut (using the face spanner provided), and gently tapping out the pin whilst supporting the cutter frame bar.

To remove the pantograph from the sliding head, remove the nut and gently tap the pin upwards whilst supporting the pantograph.

Fitting the Pantograph

Depending on the nature of the work undertaken to recondition a particular pantograph a new link spacer may be considered necessary and in such cases an oversize spacer will be returned with the pantograph. This spacer must be machined to suit the nominal dimension of the gap A, plus 0·004-in (0,1 mm). See Figs. 10 and 2. The original spacer can of course be used if its thickness is correct to measurements taken as follows:

With the pantograph correctly assembled to the sliding head set all reductions at 1:1. Close the cutter frame until the cutter frame bearing is over the end of the cutter frame bar as shown in Fig. 10. With a micrometer of 1-in to 2-in range measure across the top face of the inner race and the underside of the cutter frame bar (dimension B).

Open the cutter frame and measure the overall thickness of the inner race (dimension C). A spacer of known thickness should be added to the top face of the *inner race* to bring measurement within the range of a 1-in to 2-in micrometer.

Measure the thickness of the cutter frame bar (dimension D).

This method uses the formula:

$$A = B - (C + D)$$

where A= nominal thickness of link spacer
B= distance between arrowed faces B
C= distance between arrowed faces C
D= thickness of cutter frame bar

Machine the link spacer to dimension A+0·004-in (0,1 mm).

With reductions still at 1:1 assemble the link spacer (small diameter uppermost) and link pin and fit the nut tightening the nut securely.

Check that the pantograph moves freely at all settings between 1:1 and 50:1.

Fit the cutter frame bearing cover cap.

OPERATING INSTRUCTIONS

Operating Position

The operator should be seated on a stool approximately 2 feet (0,6 m) high with his feet on the foot mat.

When correctly seated all controls are conveniently to hand and the operator can move the pantograph style over the whole area whilst retaining the maximum operating comfort.

Electrical Controls

The rotary mains switch and starter ON/OFF buttons are on the control panel on the front of the machine. The fuse(s) for the Low Voltage Lighting Unit (an optional accessory, see page 20) will also be found on the control panel.

Cutter Speeds

The Belt Label located inside the safety cover shows how to select the pulley steps to obtain a given speed. Fig. 7 shows how the belts are fitted for correct rotational direction. A table of suggested cutter speeds and coolants for the engraving of various materials is given on page 28. See also notes on the engraving of non-metallic materials in the Supplement.

Cutter Spindles

The two types of spindle available for use with the Model K Mk. 2 machine are illustrated; the Type 'L' spindle, Fig. 11, which is the standard spindle, and has a capacity for parallel shank cutters and taper shank cutters, and the Type 'K' spindle, Fig. 12, which has a capacity for taper shank cutters only. The Type 'K' spindle is listed as an optional accessory.

Both spindles are fitted with precision ball bearings for accuracy of performance, and to provide for good quality engraving, by balanced rotation of the cutter, the taper bore is ground concentric with the axis of rotation.

Type 'L' Spindle

This spindle accepts parallel shank cutters of sizes $\frac{1}{8}$-in, $\frac{3}{16}$-in, $\frac{1}{4}$-in and $\frac{3}{8}$-in (Metric sizes: 4 mm, 6 mm, 8 mm and 10 mm) using equivalent size collets. The collet (B) and cutter are retained in the spindle by the screw cap (A). A special adapter is provided enabling standard taper shank cutters to be used with the spindle. To prevent the spindle rotating whilst the screw cap is being tightened wrench flats are provided just beneath the pulley.

Type 'K' Spindle

Provided the taper hole of the spindle and shank of the cutter are clean and the cutter firmly inserted by the cutter wrench, the cutter will be well retained during light engraving operations. For heavier engraving or when using a parallel sided cutter however, the cutter should be locked in the spindle using the retainer (B) and the screw cap (A). The cutter is firmly inserted with the cutter wrench in the normal way before fitting the retainer and the cap. The cap should then be given one or two preliminary tightenings before the final one to ensure that the retainer locates correctly.

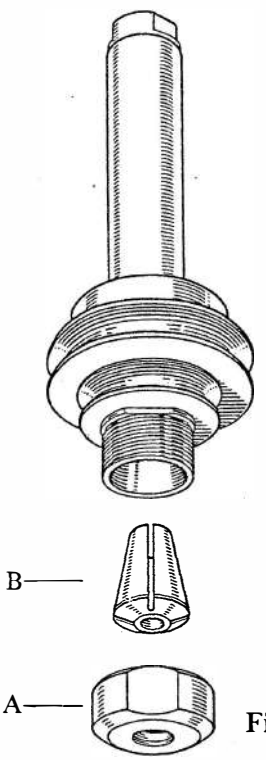


Fig. 11

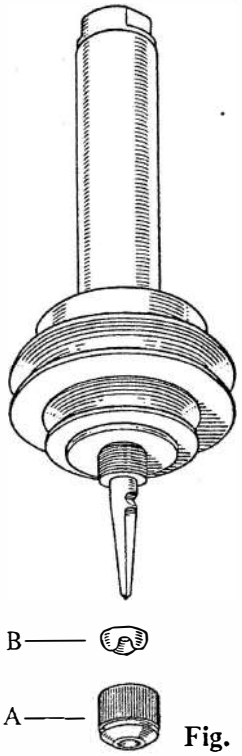


Fig. 12

Setting the Pantograph

To set the pantograph to the required reduction, slacken the clamp screw in each slider body and adjust the sliders to bring the required graduation mark in line with the index mark on top of each slider body. Clamp in position. Care must be exercised in setting the pantograph or the engraving will be distorted.

Note: Graduations for reductions of 1·1:1 to 1·9:1 are engraved on the rear edge of the pantograph head bar.

Setting the Sliding Head

Slacken the head clamp bolt and slide the head to bring the appropriate reduction figure on the scale in line with the index pin on the column. Lock the head clamp bolt.

When the sliding head is set by the scale for all reductions of the pantograph the throat depth of the machine remains constant. For reductions between 2:1 and 50:1 however, the head may be moved out beyond the scale setting to increase the throat depth. Maximum increase is obtained at 6:1 reduction with the head at the '6 EXT' position.

To obtain the maximum throat depth at a given reduction, open the pantograph so that the style is farthest from the cutter, then adjust the sliding head until the cutter frame is fully open.

Positioning the Copyholder

Directions for fitting a copyholder are given in the Erection Instructions on page 11.

An index line on the copyholder slide plate (Fig. 8) provides for rapid positioning of the copyholder and should be set to coincide with the appropriate reduction figure on the sliding head scale.

With the index line set to the scale the pantograph style will be nominally central on the copyholder when the cutter is at the centre of its sweep. When engraving at small reductions and using a large copyholder, in order to obtain maximum coverage it may be necessary to position the copyholder a little nearer the cutter. The copyholder can, of course, be set to any other position as may be found necessary, as, for example, when using the Forming Attachment, page 18.

Copy

Standard copy has bevelled edges and the copyholder grooves are similarly angled to receive the copy. The copy characters and spacers (see Layout and Spacing of Copy in the Supplement) slide into position from either edge of the copyholder. Special copy clamps are provided with the copyholder.

It should be noted that the characters on the workpiece will be engraved upside down and in a reverse direction to the copy layout.

Setting the Pantograph Style

Slacken the style clamp screw. Hold down the style with its point in the copy groove, raise the end of the style arm approximately $\frac{1}{16}$-in (1,6 mm) and re-clamp. The slight 'set' now given to the pantograph will help to keep the style in the copy. The style arm will spring sufficiently to permit the style to be moved from one character to another.

The Worktable Handwheels

Each handwheel is fitted with a graduated thimble. Each thimble is held under spring pressure and can be rotated to provide an index at any reading.

ON ENGLISH MACHINES:

The thimbles on the transverse and longitudinal motions are graduated in 0·002 inch steps up to 0·1 inch, and thus one revolution of the handwheel moves the table through 0·1 inch. The thimble on the elevating handle is graduated up to 0·05 inch in steps of 0·001 inch, and thus one revolution of the handwheel causes the table to move through 0·05 inch.

ON METRIC MACHINES:

The thimbles on the transverse and longitudinal motions are graduated in 0,05 mm steps up to 5 mm, and thus one revolution of the handwheel moves the table through 5 mm. The thimble on the elevating handle is graduated up to 2,5 mm, in steps of 0,02 mm, and thus one revolution of the handwheel causes the table to move through 2,5 mm.

Holding the Work

The worktable incorporates 7 Tee-slots 20-in long × $\frac{3}{8}$-in wide (508 mm × 9,5 mm). Table dogs and bolts are provided for clamping workpieces or workholding fixtures. When setting up for repetition work, all worktable movements should be locked to prevent accidental disturbance. Table fences can be built up around the workpiece for easy location of subsequent parts. The table fence provided is designed for clamping in the Tee slots and provides a face parallel to the longitudinal movement of the worktable.

Workholding fixtures available as accessories to the machine are described in the Accessories Section.

Using the Spindle Feed

There are two forms of spindle feed and which to use will largely depend on the type of work, or preference of the operator. Instructions for assembly of both forms are given on pages 8 and 9.

(*a*) SCREW FEED: The depth of cut is best regulated by feeding the spindle down to its stop and adjusting the height of the worktable, setting to the graduated handwheel thimble.

Fully retract the spindle. Set the stop screw (11, Fig. 5) towards the lower end of its range of adjustment so that the spindle feed can be operated through a distance in excess of the desired depth of cut, and feed the spindle down against the stop. Raise the worktable until the surface of the work just touches the cutter point; retract the spindle and further raise the table through a distance equal to the desired depth of cut. Commence engraving, feeding the spindle down to the stop for each character.

(*b*) LEVER AND SCREW FEED: The lever feed is provided for rapid lowering of the cutter to the workpiece prior to operation of the remaining screw feed, and raising the cutter to facilitate removal of the workpiece. For ease of operation the lever should be set to a position most convenient to the operator (see Assembling the Lever Feed, page 9). The position of the stop pin (19) will be determined by the amount of screw feed required in addition to the feed provided by the lever.

When engraving characters on undulating surfaces the feed stop should not be used, the depth of cut being regulated to maintain an even width of line.

Controlling the Cutter

When any revolving cutter is fed into its work at the beginning of a line as at 'A' in Fig. 13, it has no lateral displacement, but as soon as it is traversed it tends to move to one side of its proper course. In the case of the engraving cutter, rotating clockwise, this tendency is to the left of its line of advance.

Whether the displacement is perceptible or not depends upon the heaviness of cut and the degree of freedom in the machine joints.

In cutting the outlines of raised characters it is generally desirable to take roughing cuts going clockwise externally and anti-clockwise internally, round each character and to take finishing cuts in the reverse direction. Thus the cutter, while roughing, is prevented from overcutting the character, and a slight surplus of material is left for the finishing cut, which also leaves a better surface when traversed in this direction. When engraving at 1:1 or at small reductions the lack of mechanical advantage produces a tendency for the cutter to take charge and it may be necessary to go round the copy in the opposite direction to that given above. In this case, due to overcutting, a roughing cut should be taken using a larger style or smaller cutter to allow for finishing.

Fig. 13

Cutter Grinding

The bench model Cutter Grinder (Model 'G' - 110/883-S) for use with Model K Mk. 2 machine is shown on page 23. Full instructions for grinding cutters are supplied with the Cutter Grinder.

Details of the Cutter Measuring Microscope (112/292-S), which will be found invaluable in cutter grinding, are contained in a separate accessories leaflet.

ACCESSORIES for Model K Mk. 2

Milling and Forming Attachment (Figs. 14 and 15)

The Milling and Forming Attachment enables the Model K Mk. 2 Engraving Machine to be used (a) as a light milling machine, and (b) to engrave on curved or slightly contoured work.

Setting up the Attachment for Milling (Figs. 5 and 14)

The cutter frame is rigidly fixed to the machine column by the bracket of the attachment, and the work is fed into the cutter by traversing the work table. The setting up procedure is as follows:

If fitted, remove the lever feed ring (22, Fig. 5) and the thrust plug (20) and assemble the screw feed as instructed on page 8. Screw the stop screw (11) right in.

Fit the milling and forming bracket (24, Fig. 14) to the tenoned seating face on the machine column, and lightly clamp by the ½-in UN hexagon-head bolt and washer provided. Adjust the height of the bracket at the bolt to give minimum clearance between the top face of the bracket and the cutter frame (26). Fully tighten the bracket bolt.

Pass the milling plug (25) through the cutter frame (26) and into the bracket (24) and secure by the clamp screw (12) and the hexagon socket cap screw (27).

For maximum rigidity during machining the spindle should be fully retracted, and locked by screwing the stop screw down to the feed ring. The depth of cut is then controlled by the table vertical feed.

Setting up the Attachment for Forming (Figs. 5, 14, 15 and 16)

When engraving on curved or slightly contoured work a former, an exact counterpart of the form of the work, is mounted above the spindle. The former will generally be spherical or cylindrical.

The spindle is spring urged upwards so that a stylus maintains contact with the former and, as the spindle is moved under pantograph control, causes the spindle to rise and fall following the contour of the former and the work surface.

The depth of cut is controlled by a scaled feed ring, graduated in 0·001 inch steps, read off against a line provided on an index sleeve. As the stylus follows the former the scale ring rides up and down over the index sleeve and an even depth of cut over the contour of the work surface is obtained.

The maximum thickness of former at any point is limited to ½-in (12,7 mm) which provides for working over a depth of contour of the same dimension. The amount of cutter feed available will vary according to the thickness of the former, and at maximum thickness will be reduced to 0·05-in (1,3 mm).

The maximum area that can be covered is that of a circle 3-in (76 mm) in diameter.

The cutter frame is locked to the bracket during setting up so that the former, the copy and the work can be correctly positioned relative to each other. A truly ground pointed cutter will provide a means of indicating that the work is well centred beneath the spindle and the former.

The procedure for setting up is as follows:

Remove the Screw feed or Lever and Screw feed whichever is fitted. Breakdown is the reverse of assembly, see page 8.

Assemble the forming feed screw (33 Fig. 15), to the spindle quill, locking down tightly, and fit the forming feed nut (31) (left-hand thread) to the feed screw.

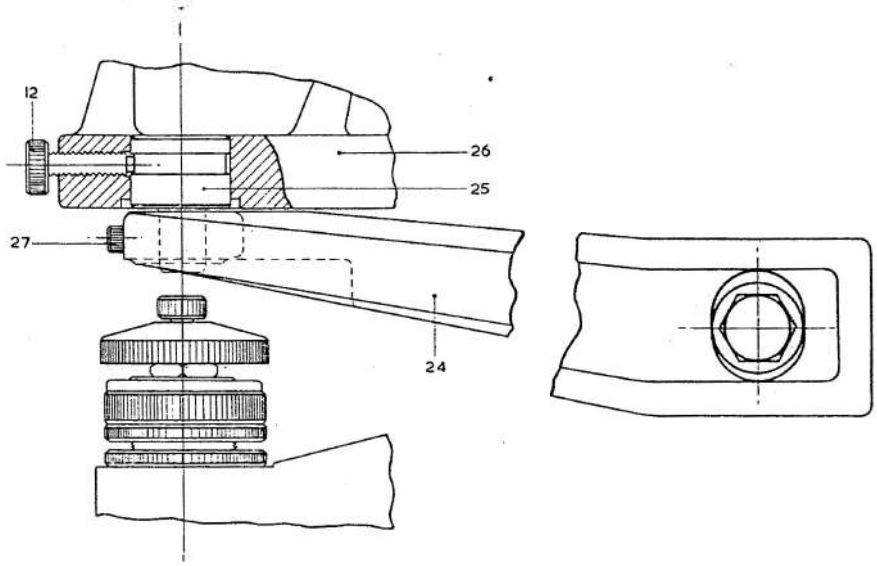


Fig. 14

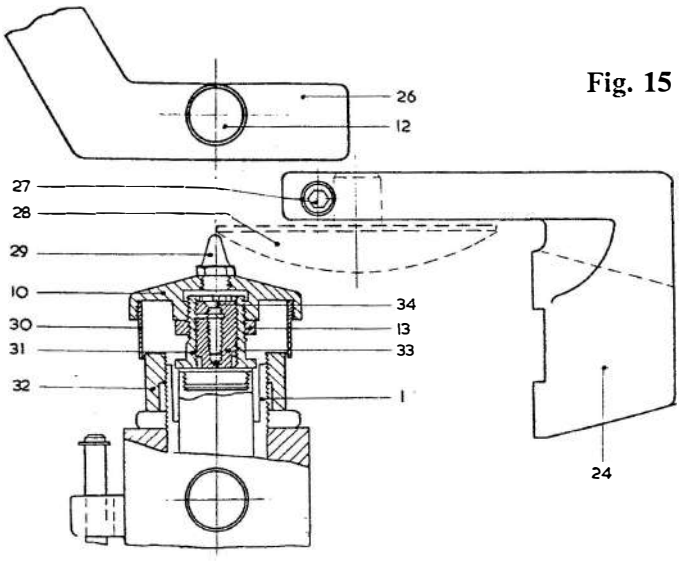


Fig. 15

Assemble the index sleeve (32) to the spindle sleeve (1) screwing down firmly.

The index sleeve is marked with three engraved lines spaced at 120° so that when the sleeve is screwed down at least one line should be conveniently placed and readily seen from the operating position, see Fig. 16. If necessary, the sleeve can be inverted when the line may come to a better position.

Place the scale ring (30) over the index sleeve and assemble the locknut (13) and feed ring (10) (both part of the screw feed assembly) to the forming feed nut, locking tightly together. Raise the scale ring and screw firmly into the feed ring.

Adjustment of feed screw friction,by the screw (34), is achieved by inserting a 4 B.A. ($\frac{1}{16}$-in A/F) hexagon wrench key through the feed ring; friction is increased by clockwise rotation of the screw.

Assemble the forming stylus (29) to the feed ring, locking down tightly. Two forming styli are provided, one of larger tip radius than the other. Generally, the stylus having the larger tip should be used on formers of large radius, and the stylus having the smaller tip on formers of small radius.

Set the pantograph and sliding head to the required reduction. Fit the bracket (24) to the tenoned seating face on the machine column, and lightly clamp by the $\frac{1}{2}$-in UN hexagon-head bolt and washer provided. Adjust the height of the bracket at the bolt to give at least $\frac{1}{16}$-in (1,6 mm) clearance between the top face of the bracket and the cutter frame (26). Fully tighten the bracket bolt.

Pass the milling plug (25, Fig. 14), through the cutter frame (26) and into the bracket (24) and secure by the clamp screw (12) and the hexagon socket cap screw (27).

Insert a pointed cutter into the spindle and position the work central before clamping. If repetition work is intended, fit table fences round the work so that subsequent pieces can be positioned without repeating the whole setting procedure. Lock the transverse and longitudinal movements of the table.

Centralise the copy to the style (which at this stage is held fixed), if necessary adjusting the position of the copyholder along the sliding head.

Replace the pointed cutter, used to indicate that the work is central, by the cutter to be used for engraving. Remove the milling plug (25), swing the cutter frame clear of the bracket and fit the former. The machine is now set up for operation.

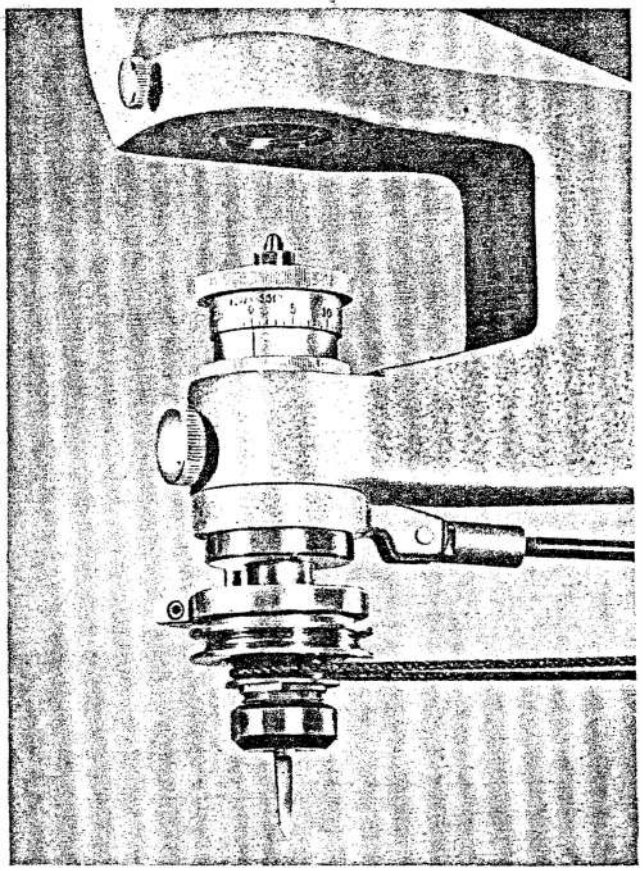
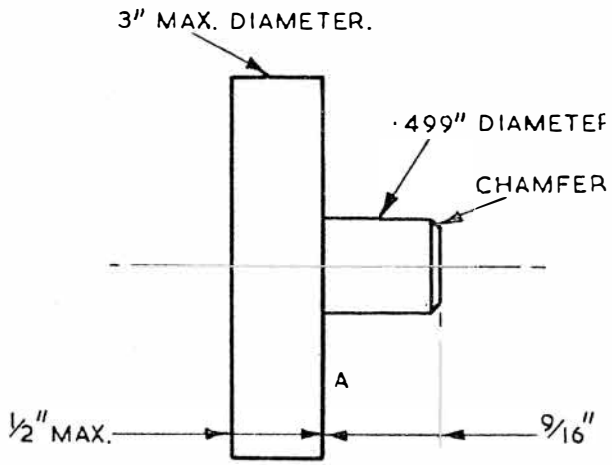


Fig. 16



FACE 'A' TO BE SQUARE TO ·499" DIAMETER.

Fig. 17

Formers

Formers should preferably be of hardened steel, and should have a $\frac{1}{2}$-in (12,7 mm) diameter × $\frac{9}{16}$-in (14 mm) long shank machined on them to fit the milling and forming bracket. The shank must be concentric with the contour on the former face.

Note: Convex formers should be made to the radius of the work minus the radius of the stylus, and concave formers made larger by the radius of the stylus.

Prepared former blanks of mild steel, 3-in (76 mm) in diameter and $\frac{1}{2}$-in (12,7 mm) thick, can be obtained from RTH. For those wishing to make their own blanks, the essential dimensions are given in Fig. 17. The method of cutting the contour out of the blank will depend on the nature of the contour; simple concave and convex surfaces can be turned, but more complex forms have to be cut on some type of three-dimensional copying machine. For users not equipped to carry out such operations, RTH will make formers, provided full information regarding the contour is supplied.

Low Voltage Lighting Unit (Fig. 18)

The lighting unit comprises a mains transformer, adjustable lamp holder with magnifying lens and incorporating a rotary ON/OFF switch, cable, cable clips, connectors and screws. Provision is made for mounting the transformer to the rear plate of the control panel and the lamp holder to the cutter frame. Circuit diagrams are included in Fig. 1 on page 5.

If the unit is ordered with the machine, the transformer will be wired into the machine and all connections up to the two-pin output socket made. The lamp holder is not fitted on despatch. Where the unit is ordered at a later date, the fitting and wiring of the transformer must be carefully carried out in accordance with the instructions supplied with the unit. Details of the voltage and phase of electrical supply should be stated at the time of ordering. The procedure given below for fitting the adjustable lamp holder to the cutter frame will apply in both cases.

Fitting the Lamp Holder to the Cutter Frame

The lamp holder is mounted, by means of a swivel clamp, on a ball joint stud attached to a hexagon screw stud.

Assemble the hexagon screw stud to the lower machined boss on the rear of the cutter frame and tighten securely. Slacken the locknut, move the ball joint to an upright position and re-tighten the locknut. Mount the swivel clamp on the ball joint and tighten the clamp nut sufficiently to support the lamp holder.

Attach the lamp cable to the cutter frame link, using the two screws and cable clips provided and leaving sufficient slack cable to permit uninterrupted movement of the cutter frame. Plug in to the socket at the top of the column. Adjust the lamp holder for best illumination of the workpiece.

Important: The mains switch on the control panel controls the supply to both the starter and the lighting unit and should be switched OFF whenever the machine is not in use.

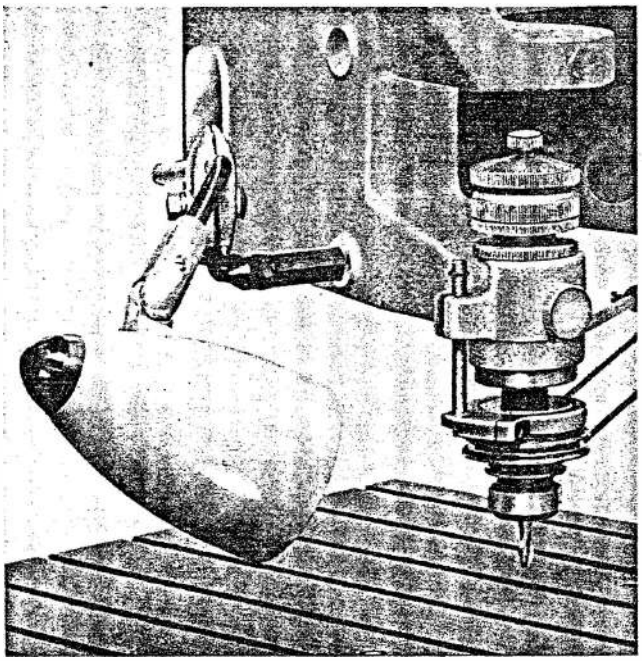


Fig. 18

STANDARD RANGE OF ACCESSORIES

Diamond Marking Tool (Fig. 19)

Articles of regular or irregular shape in a wide variety of hard and soft materials can be readily marked with this tool which incorporates a non-rotating diamond bit housed at the end of a spring-loaded plunger unit fitted to the engraving machine in place of the cutter spindle. Cutting pressure can be varied enabling an even depth of cut to be maintained. The diamond is cut to an included angle of 120°.

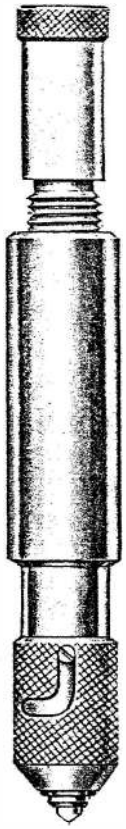


Fig. 19

The Machine Vice

This is a small vice that can be clamped with standard table fittings direct to the machine worktable, Dividing Head or the Circular Table. The long edges of the base are parallel to each other and square to the jaws. Tenon slots cut in the base also permit the jaws to be set square or parallel to the worktable Tee-slots, either by the fitting of tenons or locating the sides of the slots against the table fence.

The hardened steel jaws are 2-in (50 mm) wide, 1½-in (38 mm) deep and open to 2-in (50 mm). A loose Vee-jaw is supplied to facilitate holding cylindrical work.

The Dividing Head (Fig. 20)

The Dividing Head is used to hold and rotate circular work, such as discs, cones and cylinders, so as to present successive portions to the action of the cutter. .

The two long edges of the base are ground square to each other so that it can readily be set square to fences on the machine table. When the faceplate is set horizontal, up against the end stop, it is accurately parallel to the base and its surface is 4-in (102 mm) above the bottom surface of the base. When it is set vertical against the vertical stop, it is accurately square to the base, and the axis of the $\frac{3}{4}$-in (19 mm) bore is $3\frac{1}{2}$-in (89 mm) above the bottom surface of the base.

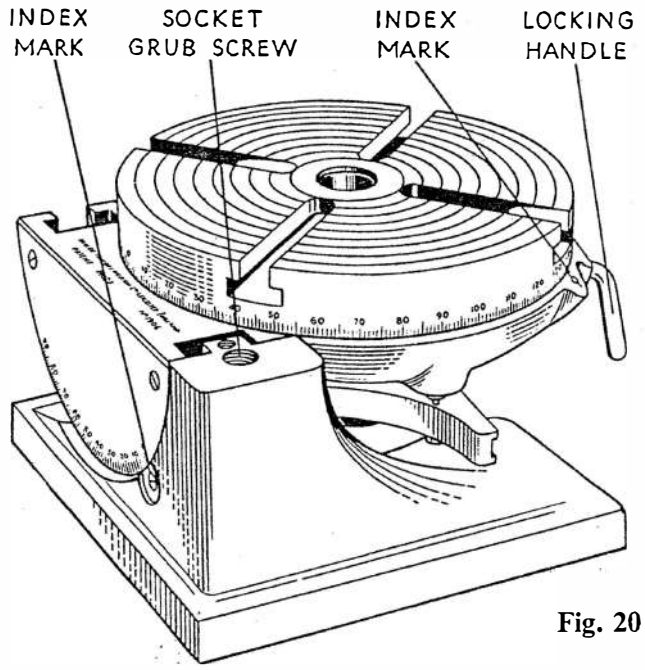


Fig. 20

The 6-in (152 mm) diameter faceplate is rotated by hand, and is locked at the desired setting by the locking handle. The canting movement is also hand operated, and is locked by the socket grub screw. Both these motions are accurately calibrated in degrees, and index marks on the fixed parts are provided.

To facilitate centring of work, a series of concentric circles is cut in the faceplate, and the central hole, $\frac{3}{4}$-in (19 mm) diameter, is accurately bored, and can thus be used to accurately locate workholding fixtures. The faceplate is Tee-slotted to receive the normal worktable fittings.

When using this attachment for engraving around circular, conical or cylindrical work, it is necessary to rotate the work step by step and to bring the copy characters in turn to one position on the copyholder. This position should generally be above the centre hole or zero of the copyholder.

Dividers (Fig. 21)

For rapid indexing of the faceplate of the Dividing Head, Dividers can be attached to the lower end of the faceplate shaft. A divider is a disc bearing notches round its periphery, and those normally made are with 12, 72, 90, 120, 180, or 360 equally spaced notches. Notches are correct to pitch within $\pm 1\frac{1}{2}$ minutes of arc.

To fit a Divider, slacken the clamp screw and remove the collar. Fit the Divider to the shaft, pushing it fully home and replace the collar, ensuring that the two pins in its face engage in the corresponding holes of the Divider; then tighten the clamp screw.

When using the Dividing Head with a Divider fitted, the locking handle should be left free, so that the table rotates freely and is held at each position by the action of the spring-loaded pawl. Dividers can be fitted to allow for anti-clockwise rotation of the table with the pawl as shown, or fitted for clockwise rotation with the pawl reversed. With the pawl swung upwards so that the tooth is as far as possible from the Divider, it can be pulled off its shaft; it can then be reversed and refitted to allow for opposite rotation.

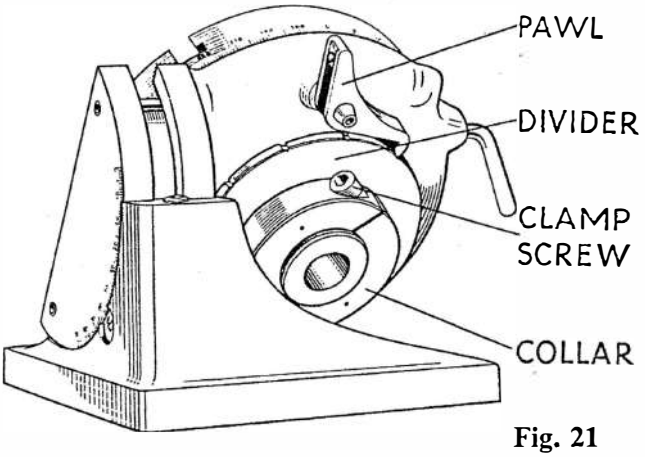


Fig. 21

The Circular Table (Fig. 22)

The Circular Table comprises a 12-in (305 mm) diameter circular rotating table, with a $\frac{3}{4}$-in (19 mm) centre hole for accurately locating the work or workholding fixtures on the axis of rotation. A series of concentric circles at 1-in (25,4 mm) spacing is provided to facilitate work centring, and Tee-slots carry the normal worktable fittings.

Cut in the base of the Circular Table is a tenon slot which can be set up against a fence in the machine worktable, thus setting the base of the Circular Table square to the machine.

Slots in the base enable the Circular Table to be clamped to the machine table with E.M. worktable fittings.

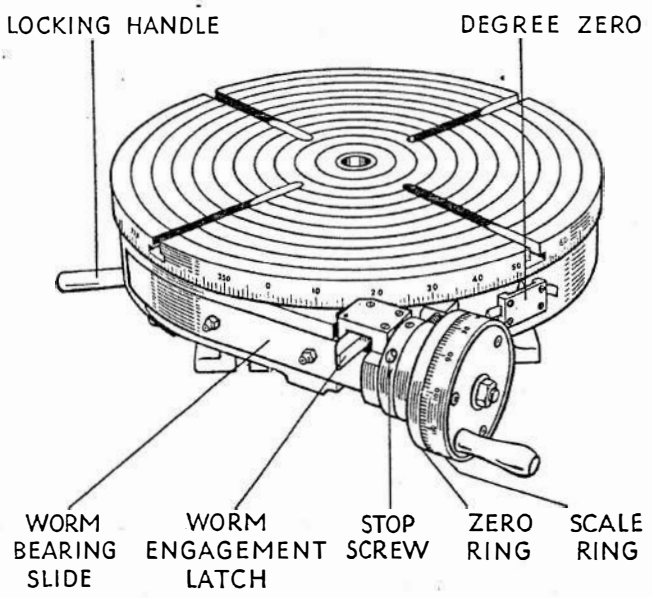


Fig. 22

The rotary table is accurately graduated in degrees, and can be rotated either by hand or by the worm; the table is clamped by the locking handle. The zero indicator against the degree scale is held by a flat spring, and can be adjusted through 5 degrees. The worm is operated by the handwheel which carries a scale ring accurately graduated in minutes, and one complete rotation of the handwheel corresponds to a rotational movement of the table of 2 degrees. The zero ring is held under friction and the zero mark can be set to any position against the scale.

To disengage the worm to allow free movement of the table, press the worm engagement latch, and move the worm bearing slide away from the table. To re-engage the worm, press the latch and move the worm bearing slide back towards the table, until it locks. If, between disengaging and re-engaging the worm, the table has been rotated, slight rotation of the handwheel may be necessary to bring the worm into mesh; it will then lock home.

If any shake should eventually become apparent in the worm, it can be taken up by screwing in the stop screw as much as is necessary to remove the shake.

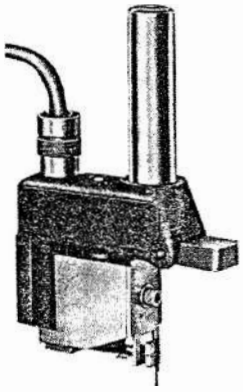


Fig. 23

Etchers

Two forms of electric etching equipment are made for use with RTH Engraving Machines. Each set of equipment consists of a transformer, suitably encased, certain accessories and a Writing Unit. Writing Units fit in place of the cutter spindle, and are moved under pantograph control in the normal manner.

The Single 'Javelin' Etcher, Fig. 23, will mark most smooth metal surfaces, is quick, clean and safe, and no prior or after treatment of the surface is necessary. Etching is effected by rapid electric sparking at the point of a vibrating electrode (The 'Javelin').

The 'Javelin' Etcher is fitted in place of the cutter spindle (see page 13 for removal of spindle) and clamped by the knurled retaining screw (4) Fig. 5. Full operating instructions are issued with the equipment.

The Resistance Etcher, which can also be used free-hand, will etch most metals having a high electrical resistance (e.g., iron and steel). Etching is effected by the localised heating and softening of the metal and is therefore not suitable for work on which there is no finishing process. It is ideal for the marking of tools, gauges, etc.

In use, the Resistance Etcher is fitted in place of the engraving spindle (see page 13 for removal of spindle) and when etching, the unit should be held on to the work with a pressure approximating to its own weight.

The Resistance Etcher is suitable only for flat work when used in the Engraving Machine.

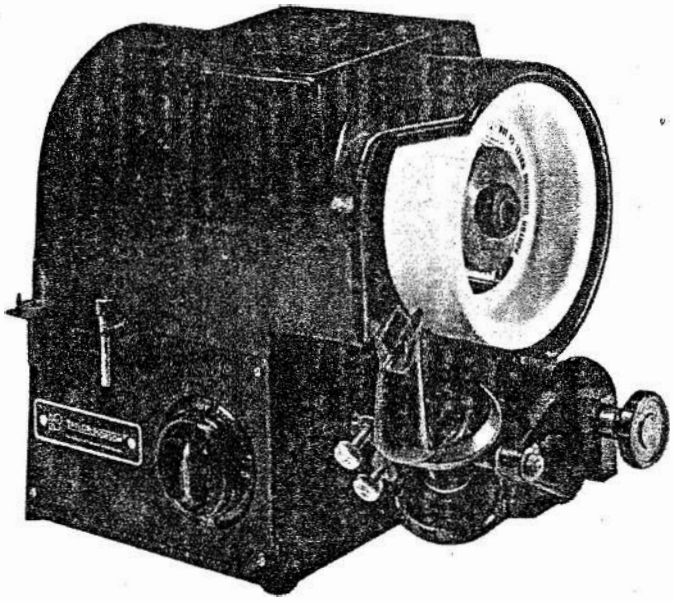
Full operating instructions are provided with the equipment.

Copy and Copyholders

A wide range of Copy in many styles is available from stock and special copy can be made on request. Copy is made in three standard sizes, the height of capital character in each case being $\frac{3}{4}$-in (19 mm), $1\frac{1}{2}$-in (38 mm) and 3-in (76 mm).

For repetition work it is normally advisable to have a set copy (i.e., all engraved on one plate) rather than make up the copy each time. RTH have facilities for making such copy, also copy bearing trade marks and other designs.

The choice of Copyholder of which grooved, Tee-slot and circular models are available, depends on the nature and size of the copy. All copyholders are interchangeable and can be fitted either parallel to, or square to, the Tee-slots in the machine worktable.



Model 'G' Cutter Grinder

SUPPLEMENT

The following pages contain certain information on the Art of Engraving. It is not intended that this should be regarded as a comprehensive and authoritative work on the technique involved, but should be regarded rather as a resumé of the more important items.

Layout and Spacing of Copy

A good general principle to follow is that for the work produced to have a pleasing appearance, the spacing of the copy must be right, and for the spacing to be right, it must look right.

When arranging standard copy characters in the copyholder, it is normally only necessary to have the blanks, on which the characters are cut, in contact to achieve good spacing. These blanks are designed so that when they are in contact they give the best spacing with average combinations of characters, though certain combinations will not look right (e.g., in the word 'HILT' the HIL appear crowded, and the L and T widely spaced). To adjust such spacings, spacers of various widths are supplied with all sets of standard copy.

When arranging a set copy (i.e., copy the whole of which is cut on one plate), the copy should be designed to have a balanced appearance.

Size of Copy and Work

By varying the reductions, the same size of engraving may be obtained from copy of different sizes. For example, characters $\frac{1}{4}$-in (6,3 mm) high may be engraved from $\frac{3}{4}$-in (19 mm) copy with a 3:1 reduction, from $1\frac{1}{2}$-in (38 mm) copy with a 6:1 reduction or from 3-in (76 mm) copy with a 12:1 reduction.

When using large copy and a fairly big reduction ratio, there is greater leverage on the pantograph, and, therefore, better cutter control; also the copy is less subject to wear, and, due to the large reduction, any small amount of wear would not be apparent on the work. The use of small copy is normally advantageous when the complete copy is of great length and it is desired to engrave the complete inscription at one setting.

Lengthy Inscriptions

If the complete copy requires more characters than can be accommodated in the copyholder at one setting, the complete copy should be laid out with correct spacing on a table and measured, note being taken of the central character which will serve as a key for set-up. The pantograph reduction can be calculated if the area to be engraved is known, or vice versa. Place half the copy, including the key character, in the copyholder, and arrange the work so that its centre line is under the cutter when the pantograph style is centred in the key character (which should be at one end of the copyholder). Clamp the work, and then engrave the key character followed by all the others in the copyholder. Remove this copy and replace it with the other half, still retaining the key character but with it at the other end of the copyholder. Adjust the worktable so that the cutter coincides with the engraved key character when the pantograph style is in the corresponding copy character.

Engraving from Line Copy (*i.e., Copy formed by a simple Vee groove which matches the 90 degree conical point of the pantograph style*)

The height of line copy is measured from centre of line to centre of line, and the height of the engraved characters is height of copy ÷ pantograph reduction + width of cut. The width of cut can only be varied by varying the width of the cutter, and, if a balanced appearance is to be maintained, this can only be done within certain limits. If too wide a cut is taken, the engraved characters will be disproportionate, and in extreme cases the small lands (as in a and e) might be completely cut away. As a general rule the width of cut on block capitals should be approximately one-eighth of the height of the engraved character; it should never exceed one-fifth.

EXAMPLE: Using $\frac{3}{4}$-in (19 mm) copy and engraving with a 10:1 reduction, the characters will be 0·075-in (1,9 mm) high on centres. Dividing 0·075-in by eight gives a width of cut of 0·009-in (0,23 mm) so that the overall height of the character is 0·075-in (1,9 mm) + 0·009-in (0,23 mm) = 0·084-in (2,13 mm).

Engraving from Sunk and Raised Copy, Using Style Rollers

When engraving from sunk and raised copy, in order that the engraving shall be a faithful reproduction of the copy the following relationship must be satisfied:

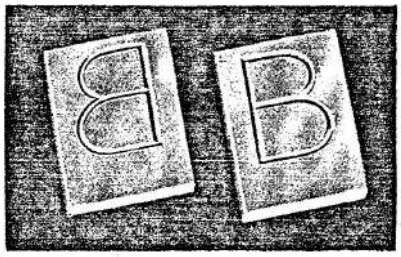
Diameter of style or roller =
Diameter of cutter × Pantograph reduction conversely

Diameter of cutter =
Diameter of style or roller ÷ Pantograph reduction.

Thus with 10:1 reduction and a 0·50-in (12,7 mm) diameter roller, the cutter must be 0·05-in (1,27 mm) diameter.

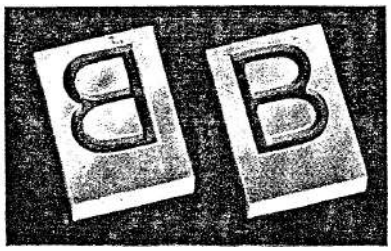
This relationship applies to cylindrical cutters, and to conical cutters if the diameter is measured at the work surface when the depth of cut is correct. If the engraving is in a moulding die the diameter of the cutter at the bottom of the cut must be proportionate to the roller diameter, as it is this part that will be the surface of the finished product.

When using rollers, roughing cuts should be made using the largest roller that will fit in the general shape of the copy, and with the proportionate cutter diameter. Gradually reduce the size of the roller together with that of the cutter, until the finishing cuts are taken using a roller of such diameter that it will move in and out of all the details of the copy.



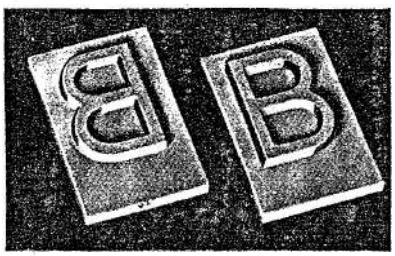
LINE COPY

Line Copy, as illustrated above, uses a pointed style, matching with a Vee-groove forming the outline of the character. With Line Copy, the width of line on the letter being engraved can only be varied by changing the size of the cutter, or by using what is known as Multiple Line Copy, where thick and thin lines appear.



SUNK COPY

Sunk Copy, as illustrated above, is basically of the form shown, but can have varying widths of line, such as may be required for Roman, Old English, Script, etc.



RAISED COPY

Raised Copy is basically of the form shown above, but here the width of line or face may be varied to produce counterparts of the copy referred to under the heading Sunk Copy—that is, Roman, Old English, Script, etc.

Raised Copy necessitates clearing away surplus metal around each of the characters. It must be realised that metal must be left on which to engrave the next letter, so that it is important to use a set copy, consisting of all the characters mounted on one piece of metal, in the correct relation to one another.

Engraving on Non-Metallic Materials

Plastics and Laminates

Thermoplastics and rigid laminates can be satisfactorily engraved using high speed or carbide cutters. A selection of some of the more common materials in these groups, together with recommended information for obtaining best results, is given in the table of cutter speeds on page 28.

Marble

Marble can be engraved satisfactorily, using Speedicut steel cutters well lubricated with water and running at about 5,000 rev/min for $\frac{1}{4}$-in (6,3 mm) letters. Cutter clearance should be 40°.

Wood

Cutters for wood should have the cutting edge angles made acute, and this can be done by grinding the flats past the cutter axis. A high speed is desirable for wood.

Glass

Diamond cutters are available but these are only suitable for 'scratching' the surface of the glass.

Set Copy

Where any inscription is to be engraved repeatedly, for example a firm's name or trade mark, the copy should be engraved on one plate as set copy.

RTH have special facilities for making set copy to customers' requirements.

Well-designed set copy saves time and gives a finish and uniformity to work which is not obtainable by means of loose characters.

Set copy is sometimes used in conjunction with loose characters. For example, inscription plates for electro-motors, machine tools, etc., may have to be engraved with progressive serial numbers, in addition to a repeated inscription. In such cases a set copy carries the repeated matter and is provided with slots in which the serial numbers can be built up with standard copy figures.

In the case of inscriptions too large to be engraved at one setting, the set copy may be in two or more parts; and to ensure engraving these in correct relation the copy and the workholders may be provided with registers such that at each re-setting the copy and work will be located in the correct relative positions.

Where the expense of such provision is not justified, the set copy may be made to overlap so that after a change of copy the work may be placed correctly by setting the style in the overlapping part of the copy and setting the engraved portion of the work correspondingly under the cutter.

Set copy too large for standard copyholders may be adapted by mounting it on standard bevelled strip. Alternatively it may be held on the No. OJ Tee-slot copyholder which measures 20-in × 12-in (508 mm × 305 mm).

For circular set copy see page 26.

Built-up Set Copy

Copy may sometimes be made by using standard copy characters stuck down with wax (80% rosin or colophony and 20% beeswax) to a foundation of wood or stiff card.

Temporary Copy

Temporary copy in sunk, raised or line style is very conveniently made from transparent cellulose acetate sheet* about $\frac{1}{32}$-in (0,8 mm) thick. It is cheap to make and with care can be used about 30 to 100 times.

The copy is made direct from an enlarged drawing by placing the transparent sheet over it and tracing the diagram with a steel scriber; a straight edge and french curves may be used as guides.

A cut two-hundredths of an inch (0,5 mm) deep is quite sufficient to guide the style.

Line copy may be cut with a standard hand graver which can be obtained from small tool suppliers.

Copy for sunk or relief engraving may be made as above by scribing the lines deeply and breaking the sheet along the lines. The point of a knife may be used instead of a scriber.

The copy should be tacked down to wood or stout card in order to protect it and hold it out flat. Shoe tacks should be used and should be placed close to the cut or the edge, as the case may be, so that there will be no tendency for the copy to lift and become distorted.

It is advisable to hammer the tacks in about two-thirds of their length only, then to cut off the heads with a pair of side cutting pliers. This avoids any tendency to split the copy material. The tack stumps are hammered flush with the surface to avoid injuring the operator.

* A most suitable material is 'Celastoid', a product of British Celanese Limited.

Material for Copy

Hard-rolled ENGRAVERS' brass 0·064-in (1,63 mm) thick has proved the best material for permanent copy. Copy of hardened steel has a longer life but the first cost is considerably more and there are difficulties in hardening long set copy without warping.

Care of Copy

Copy should be kept free from grit and be lightly oiled from time to time. Line copy lasts a long time if the style is kept properly ground. Styles are cheaper than copy, and should be re-ground regularly.

Grinding the Pantograph Style

This should normally be ground on an RTH Cutter Grinder, and with the crutch correctly set it is a simple matter to grind the style properly. A stop collar is provided for the purpose of holding the style, and locating it in the Vee of the crutch. First grind an angle of 30 degrees, and finally grind to 90 degrees, using the Vee groove in the stop collar for checking the 90 degree angle. Remove the sharp point with an oilstone, leaving a flat of about 0·005-in (0,127 mm).

Circular Engraving

Engraving falls into three classes:

(1) In straight lines on flat surfaces or along cylinders. This is done from standard or set copy held in standard copyholders and requires no special equipment.

(2) In curved lines from curved set copy. Set copy must be used for engraving on curves which are not circular, and should be used for circular curves where the amount of work to be done justifies the outlay. Curved copy for temporary use may be made by mounting separate copy characters with wax on pieces of plywood or cardboard. See paragraph on the 'balancing' of unsymmetrical characters.

(3) In circular curves or around circular surfaces from copy moved with the work, step by step. This may be done on the dividing head, described on page 22, used in conjunction with the circular copyholder or with loose or set copy mounted in a standard copyholder.

Balancing the Characters

In engraving curved lines of characters on the flat or on shallow cones, the 'balance' of the characters requires attention. If unbalanced characters like L and J are set with their centres radial to the centre of the curve, they will appear to be falling over as compared with symmetrical characters such as A and O. To correct this it is necessary to displace the unbalanced characters; in the case of the L, for example, its vertical line should be nearly radial.

Reduction Formula - Intermediate Reduction

The setting of the pantograph for an intermediate reduction, that is, a reduction for which a scale line is not provided on the pantograph, can be worked out using the following formula which gives the distance D, *in inches*, at which the index line on each slider body has to be set from the 1:1 line on the bars.

$$D = 8{\cdot}3125 - \frac{16{\cdot}625}{R+1}$$

where R = reduction

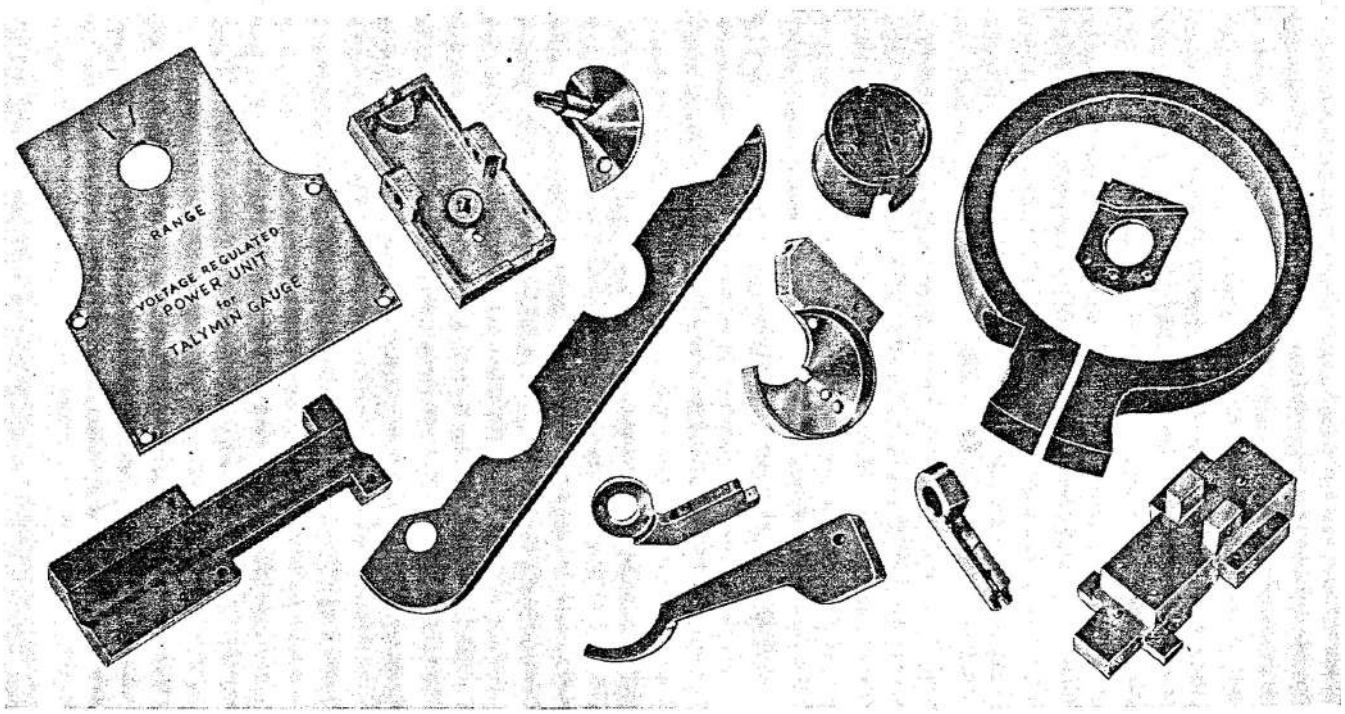
The following example is based on a reduction requirement of 11·5:1, not marked.

$$D = 8{\cdot}3125 - \frac{16{\cdot}625}{11{\cdot}5+1} = 8{\cdot}3125 - 1{\cdot}33 \text{ inches}$$

$$D = 6{\cdot}9825 \text{ inches}$$

For an accurate reduction of 11·5:1, the index line on each slider body is therefore positioned at a distance of 6·9825 inches from the 1:1 scale line.

The position of the sliding head for an intermediate reduction should be to the nearest marked reduction, i.e., for the above example, either 11 or 12.



Some examples produced by Profile Milling

PROFILE MILLING

Profile milling on the Pantograph Engraving machine is an efficient and convenient means of producing simple or complex shapes which, in many cases, would prove costly to produce by conventional methods.

A full account of profile milling cannot be given here as the method of approach will obviously vary according to the shape of the workpiece, the material used, and to some extent the knowledge and experience of the machine operator. The following gives only a brief account of the basic requirements.

An exact copy of the profile to be milled, in either sunk, raised or line style copy, usually many times larger than the original, is made up in sheet brass (or other suitable materials) as required. The coverage required and consequently the reduction used will generally determine the final size of the copy. A style roller is used to guide the pantograph round the copy and to obtain the finished dimensions the diameter of the roller must be equal to the diameter of the cutter multiplied by the reduction used. Typical engraving machine cutters such as parallel sided engraving cutters, fluted end mill or slot drill cutters will be found suitable for profile milling. Selection of the appropriate cutter is generally influenced by the nature of the work, material to be cut and the amount of stock removal.

Roughing cuts are generally taken using the largest roller that will fit the general shape of the copy. In cases where the machined profile is fairly large and without small details in shape, the finishing cut can be taken with the same size cutter as used for roughing, in combination with the final size of roller. Some intricate shapes will demand the use of a small diameter cutter and in this case roughing down to almost finished size should be carried out using a larger diameter cutter and a roller that is slightly oversize in proportion to the cutter used. The amount of material left for removal at the finishing cut (usually 0·005-in (0,127 mm) is sufficient) will largely depend on the finish required and the tolerances allowed on dimensions.

In the case of production workpieces, where a component is to be milled on more than one face and a definite relationship exists between such faces, each separate copy should be made with two common datum edges which are set against fences or stops on the copyholder. Fences or stops must also be mounted on the machine work table for location of the workpiece or such work-holding fixtures that may be used. Milling can be carried out at different levels on one face by re-setting the spindle feed depth stop or by adjusting the height of the work table.

CUTTER SPEEDS

For general letter engraving Axiflat Cutters are recommended.
For Letter Punches and Die work Rigiflat Cutters should be used.

Material	Type of Cutter	Width of Cut up to		Clearance Angle	Rev/Min of Cutter	Recommended Coolant
Free Cutting Brass	Talyspeed	0·10-in	2,5 mm	32°	18,000	None
Sheet Zinc	Talyspeed	0·10-in	2,5 mm	40°	18,000	A
Tough 'Cartridge' Brass	Talyspeed	0·01-in 0·10-in	0,25 mm 2,5 mm	40° 40°	18,000 12,000	D or E
Aluminium	Talyspeed	0·10-in	2,5 mm	40°	18,000	A
Mild Steel	Talyspeed or Speedicut	0·01-in 0·10-in	0,25 mm 2,5 mm	40° 40°	18,000 12,000	D or E
Copper	Talyspeed	0·01-in 0·10-in	0,25 mm 2,5 mm	40° 40°	18,000 12,000	E or A
Staybrite Steel	Talyspeed or Speedicut	0·05-in 0·10-in	1,25 mm 2,5 mm	40° 40°	18,000 15,000	C
Tool and Die Steel	Talyspeed or Speedicut	0·05-in 0·10-in	1,25 mm 2,5 mm	32° 32°	8,000 5,000	D or E
Vybak	Speedicut	0·06-in	1,5 mm	40°	5,000	A or B*
Cobex	Speedicut	0·06 in	1,5 mm	40°	5,000	A or B*
Perspex	Talyspeed	0·10-in	2,5 mm	40°	18,000	None
Formica Engraving Material	Carbide	0·06-in	1,5 mm	32°	18,000	None

Coolant A: Paraffin.
Coolant B: Pure Turpentine.
Coolant C: Pure Turpentine and powdered Camphor mixed in the proportions four fluid ounces Turpentine to one ounce Camphor.
Coolant D: Frapol No. 77 (sold by Edgar Vaughan Ltd., Legge Street, Birmingham) diluted with Turpentine (3 to 1)
Coolant E: Ragosine R.T.D. Compound (obtainable from Rocol Ltd., Rocol House, Swillington, Leeds, England) mixed with Paraffin in equal proportions.

The Cutter Speeds quoted were found to be acceptable at the time of investigation, but it should be appreciated that variation in speeds may be necessary depending on material characteristics.

*Rigid thermoplastics such as Vybak and Cobex are vulnerable to overheating during engraving, resulting in softening and poor definition of characters. As an alternative to liquid coolant a cool air blast directed around the point of the cutter will be found helpful both in the removal of swarf and the prevention of overheating.

19 - 8/365 AP

Printed in England