OPERATING INSTRUCTIONS & PARTS LIST

TYPE '300' COPYING UNIT

COLCHESTER

4½ CRN HEIGHT

HEPWORTH TYPE 300 HYDRAULIC COPYING EQUIPMENT

OPERATING INSTRUCTIONS AND PARTS CATALOGUE

Issued by:
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GENERAL DESCRIPTION

Hepworth type 300 copying equipment consists of the following six assemblies:—

1. Profile slide.
2. Swivel-mounted toolbox.
3. Rear beam and tailstock.
4. Pump set and flexible pipes.
5. Turret stop (optional extra).
6. Facing beam (optional extra).

Profile Slide Assembly

This assembly slides on a base which can be attached to the lathe in one of four alternative positions viz., parallel to, or at an angle of 30, 60 or 90 degrees to the lathe centre line.

The profile slide incorporates a hydraulic actuating cylinder, with a fixed ramshaft attached to the base slide, and a hydraulic control valve cartridge with all necessary internal porting. It also carries the stylus lever bearing assembly and the retraction assembly.

Precision ground V-slides are used and rigid strips are fitted for wear adjustment. An adjustable retraction stop is provided.

A flat port plate bolted to the underside of the profile slide provides the necessary oil ports between the valve and the cylinder. This plate is extended beyond the profile slide to provide a grouped entry boss for the three nylon pipes (two $\frac{1}{4}$ in. bore, one $\frac{1}{8}$ in. bore) from the pump set. Two adaptors, one on the pump set and one at the entry point, secure the flexible metallic armouring which protects these pipes. Fig. 2 identifies the three pipes for installation purposes.

Control Valve

Carried in a flanged housing and secured in the profile slide, with suitable seals, the control valve is a self-contained assembly. Every valve is calibrated at the works and performance details are individually recorded. A complete replacement can be obtained but component spares are not supplied.

Stylus Lever

The stylus lever is rigidly attached to a vertical pivot shaft mounted on pre-set angular contact bearings within the profile slide casting. The outer end of the stylus lever embodies a mounting hole for the vertical stylus rod, which is adjustable in height. The rod in turn carries the stylus itself.

An operating tappet for the control valve is carried on the pivot shaft together with an adjustable nut which provides a setting face for the speed control unit.

Retraction Handle

This assembly consists of a manually operated eccentric acting on the valve tappet. It is controlled through a hand-lever conveniently situated on top of the unit. An eccentric shaft carried in the lever boss is adjustable to give control of forward velocity. The retraction handle is positively detented in both the ON and OFF positions.

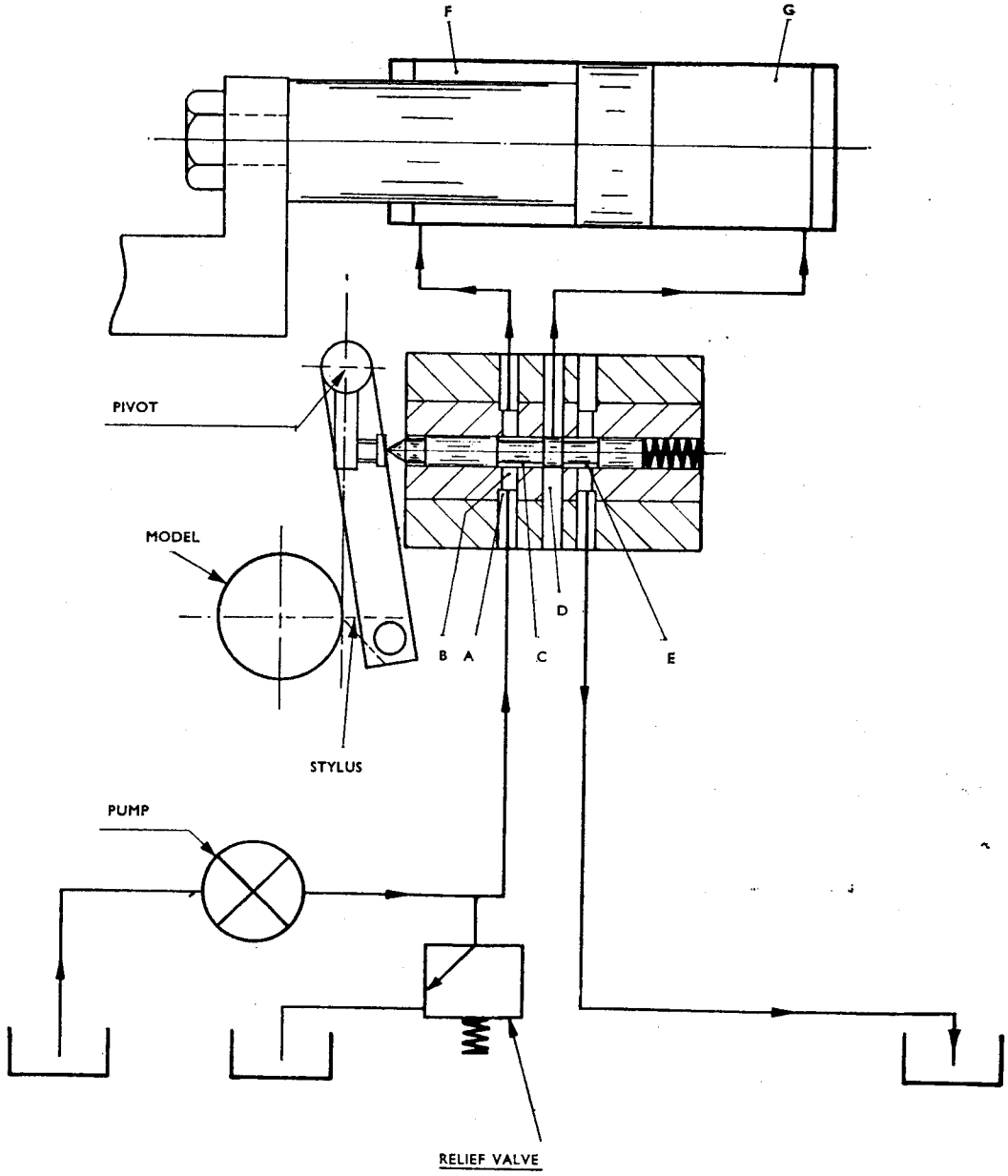
Toolbox

Built on to a base slide which spigots into the front of the profile slide, this assembly is capable of being mounted in four alternative positions corresponding to those obtainable on the profile slide mounting.

The toolbox is arranged for interchangeable tool-holders and is provided with micrometer adjustment over a distance of $\frac{1}{2}$ in. A heavy-duty slide lock fixes the toolbox during cutting. Whilst all the tool assemblies are capable of accepting the standard interchangeable tool-holders for boring and turning, the base slides are supplied in three alternative thicknesses, to suit 5 in., 6 in. and 7 in. lathes.

Rear Beam

The steel beam, which is surface-mounted to the rear of the lathe bed, is angled on its edges to suit the two beam-carrying brackets. These brackets, which are secured by heavy locking clamps, can be freed to slide along the beam to the required position.



HYDRAULIC CIRCUIT

Fig. 1

The left-hand bracket, i.e. that nearest the headstock as viewed from the front of the machine, carries a spring-loaded tailstock housing which is free to slide on the bracket in a plane normal to the lathe centre line. Approximately $2\frac{1}{2}$ in. adjustment is provided. The right-hand bracket carries an adjustable tailstock assembly mounted on a base which is also free to slide in the same plane.

Both tailstocks are capable of being adjusted relative to the lathe centre line in order to accommodate the stylus position at various angular settings of the profile slide. A locking handle is provided on each tailstock assembly.

Alternative beams, in all specified bed lengths, are available for each size of lathe.

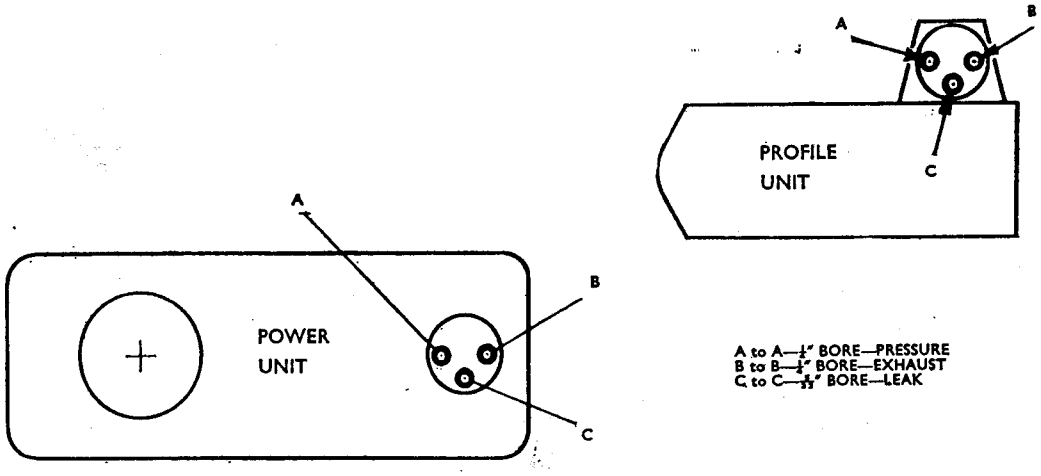
Each tailstock housing carries a flat machined platform to accommodate templates. Short templates can be mounted on the right-hand tailstock body only, in which case the normal length adjustment provided for the model is also suitable for the template. With longer templates it is necessary to use the left-hand mounting face for additional support. In this case the template bolting hole must be slotted to enable a longitudinal setting of the template to be achieved.

Pump Set

The self-contained tank assembly incorporates a motorised rotary pump of 0·6 g.p.m. capacity, which has an in-built relief valve set at the factory to 300 p.s.i. A wire mesh suction filter and a micronic pressure line filter are incorporated in the piping which is taken through the lid of the tank and grouped within a circular boss. Three screws secure the tank lid and the complete assembly of motor, filters, pump and piping can be withdrawn from the tank body in one piece. An oil level indicator gives a clearly visible oil reading at the required oil volume of five imperial gallons.

A pressure gauge is provided as standard equipment.

Mounted on the top of the motor is a direct on-line push-button starter. As with the motor itself, alternative types are available to suit the specified electrical supply. All motors and starters comply with C.S.A. requirements as specified.



PIPE CONNECTIONS

Fig. 2

Hydraulic Circuit

As illustrated in Fig. 1, pressure oil from the pump passes through the relief valve enters the control valve at annulus A, and flows directly to the ramshaft end of the cylinder F. In addition, pressure oil from annulus A passes through two drilled ports (B) to the valve spool chamber C and thence into annulus D through the first restriction, which is formed by the valve spool and the liner end. A second restriction is interposed before the pressure oil reaches the valve spool chamber E, which is connected to tank. Annulus D is connected to the cylinder at G.

The supply pressure thus passes to sump through two variable orifices. Longitudinal deflection of the valve spool in the direction of the spring increases the pressure drop from chamber C to annulus D. Conversely, deflection against the spring decreases the pressure drop. Since the supply pressure is ultimately dropped to sump, a longitudinal position of the valve spool can be achieved at which the pressure drop is equal across each orifice: in this position, pressure in annulus D is half the supply pressure.

The cylinder is so arranged that the area of the end of the ramshaft F is half the area of the end of the piston G. Since supply pressure operates on half the area of F while only half supply pressure operates on the full area of G, the forces on the piston are equal and opposite: consequently, the cylinder is at rest in a pressure-balanced condition.

The contact of the lever-mounted stylus on the model maintains the unit in this balanced condition until a deflection of the valve results from an increase or decrease in model diameter being encountered during a longitudinal feed. Deflection caused by an increase in model diameter will produce a cylinder movement to the right, taking with it the pivot of the stylus lever and thus enabling the valve spring to restore the balanced condition at a new diameter. In a similar manner, a decrease of model diameter will result in deflection of the valve away from the spring and the movement produced will restore balance at the reduced diameter.

External over-riding deflection of the valve spool produced by the mechanical retraction system against the spring moves the cylinder away from the model to the limit of cylinder stroke.

Turret Stop

Available as an optional extra is a turret stop conversion kit consisting of four separate assemblies, namely:—

1. A turret stop, together with operating handle, carrying six different length stations.
2. An adjustable stop bracket.
3. An extended valve lever complete with tappet screw and locknut.
4. A speed control housing assembly.

A square cover plate fitted at the right-hand side of the profile slide is removed and is replaced by the turret stop assembly, using the same screws.

This turret stop is designed to operate through a limited angular displacement. When the handle is moved away from the unit, the slide is retracted.

Movement of the lever towards the profile slide advances the unit and indexes the turret drum by one station. As the unit advances, the selected stop contact the fixed stop on the base slide and the profile slide is balanced at the set diameter of workpiece. Progressive settings of the stop pegs enable roughing cuts of uniform depth to be taken. The final cut follows the full template at an inoperative station of the turret stop.

When this unit is fitted to the machine, the operating handle is used for normal advance and retraction of the profile slide regardless of whether or not the turret stops are in use. The normal retraction handle assembly is therefore removed from the machine this being achieved by withdrawing the pin which secures the graduated dial, thereby enabling the handle boss to be lifted off. This in turn gives access to two cap screws securing the cam plate. The plate and eccentric shaft should then be removed. The replacement assembly can then be bolted into position, using the same fixing holes.

With the unit running in the advanced position, the graduated dial should be rotated until the forward speed is reduced to the desired minimum.

NOTE—When using the turret stop, projection of the stylus rod above the stylus lever is not permissible; the rod must therefore be shortened to suit.

Facing Beam

Also available as optional extra equipment are facing beam assemblies in three sizes to suit 5 in., 6 in. and 7 in. lathes respectively.

The appropriate assembly is fixed to the saddle extension pieces and set so that movement of the template beam takes place at true right angles to the axis of the lathe bed. Control of this movement is through micrometer screw adjustment. By use of a dial indicator, this datum slide setting can be checked for parallelism against the surfacing slide.

In use, compound adjustment for face profiling is obtained by micrometer adjustment at the toolpost (controlling depth of form) and at the template (controlling diameter).

FITTING TO LATHE

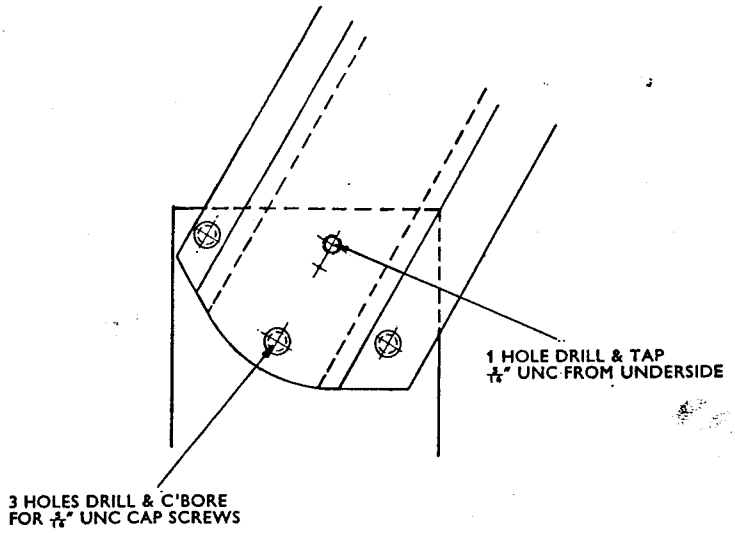
Rear Beam

A steel beam is attached to the facing at the rear of the lathe bed, utilising tapped holes for mounting purposes. The beam should be parallel to the lathe bed, a dial indicator being used for checking purposes.

After the tailstocks have been clamped in position, the model carrier assemblies should be set by laying a test bar between centres parallel to the lathe axis.

Profile Unit

This unit is despatched from the factory with the cylinder closed. Opening the cylinder exposes three counterbored holes (see Fig. 3). These are provided for the purpose of attaching the unit to the lathe cross slide in the desired position. Three $\frac{5}{16}$ in. U.N.C. cap screws are provided. An additional $\frac{5}{16}$ in. cap screw inserted from the underside of the lathe into a tapped hole in the base of the profile unit completes the fixing.



UNIT MOUNTING

Fig. 3

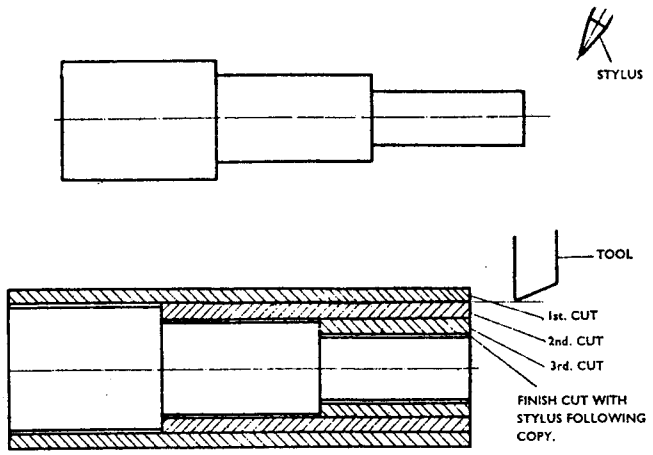


Fig. 4 Shaft Turning

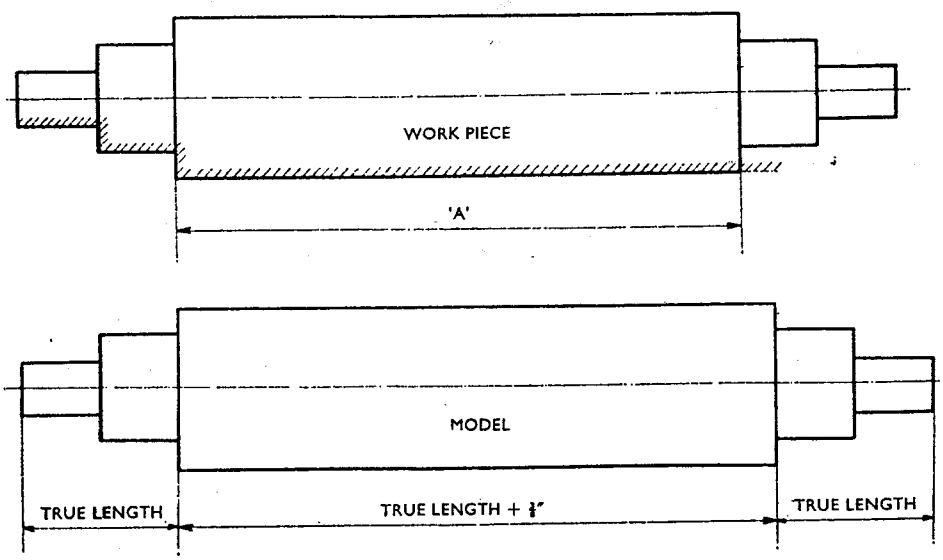


Fig. 5 Blending Machine

Pump Set and Piping

This free-standing assembly is intended for positioning as shown in Fig. 2. The three nylon pipes supplied should be connected to the unit in accordance with Fig. 2 and protected by clipping the armoured sheath in position. Having filled the tank (capacity approximately five imperial gallons) to the indicated level with Shell Tellus 33 hydraulic fluid or equivalent, the unit is ready for running.

Commissioning the Unit

On starting the unit, the following simple check should be made:—

1. That the unit reacts accordingly when the retraction lever is moved away from the operator, i.e. towards the lathe headstock, and advances when the lever is moved in the opposite direction. These functions are related to the position of the valve spool and are set at the factory.

It is advisable to start up with the unit in the retracted position.

2. That there is no air in the hydraulic system. Air is bled from the system by easing the two bleed plugs on the cylinder. The plug on the upper surface of the body bleeds the front of the cylinder and the rear is bled by the plug at the back. The rear of the cylinder should be bled with the unit advanced. Between each bleeding the unit should be moved backwards and forwards. This sequence of operations should be repeated until all air has been expelled and the unit moves smoothly. The bleed plugs should be firmly tightened before the unit is run.

3. That the workpiece and model are mounted and that the tool is set to centre height. The longitudinal position of the model should be set with the stylus in contact with the end of the model and the tool contacting the component at the corresponding point.

Operating the Unit

The method of turning the component down to size can be varied but it is suggested that the cross slide be taken towards the rear of the lathe with the unit fully advanced: this leaves the full stroke available for profiling. Using the normal cross slide handwheel, the tool can then be brought to the workpiece and turning commenced with the tool slide on the unit set back to the full extent of its adjustment.

At this point the stylus may not be in contact with the model. In this case, successive cuts should be taken in the manner described (Fig. 4) until the stylus picks up the model along all its diameters. When this has been achieved, final setting of one diameter is obtained by means of the depth-of-cut slide provided on the toolbox. Longitudinal setting of shoulders to the model is effected by turning the handwheel on the adjustable model tailstock.

When a turret stop is fitted, roughing cuts can be taken by the action of rotating the stop.

The tool should always be retracted from the workpiece before the saddle is returned.

Blending Procedure (see Fig. 5)

As most shafts involve diameter steps at each end and have a parallel portion at the maximum diameter, it is usually necessary at some stage of the machining operation to turn the workpiece end-for-end in the lathe.

As it is not desirable to blend the machining along the central diameter, it is suggested that this portion be turned to a point beyond its first reverse shoulder. In order that this can be achieved without the tool plunging (as it would on a size-for-size model), the length of the model is increased, as shown, by approximately $\frac{3}{8}$ in. in order to enable the operator to retract the tool after it has turned beyond the true component length. When the workpiece and model have been reversed, the shoulder is set to give the correct length and the tool is retracted before it travels along the top diameter—which has previously been machined.

Screw Cutting

Use of the copying equipment enables improved screw threads to be cut by a single-point tool mounted in the toolbox of the profile unit.

With the unit in the fully advanced position, a 90 degrees run-out face is arranged on a model, the longitudinal setting being arranged to coincide with the screw-cutting withdrawal

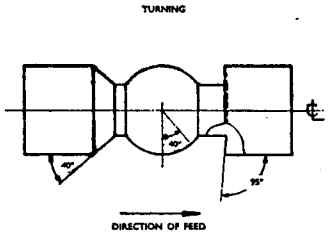


Fig. 6

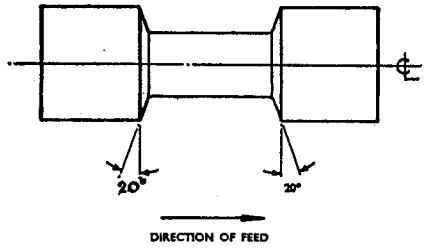


Fig. 7

Turning—Unit respectively at 60 degrees and at right angles to lathe axis

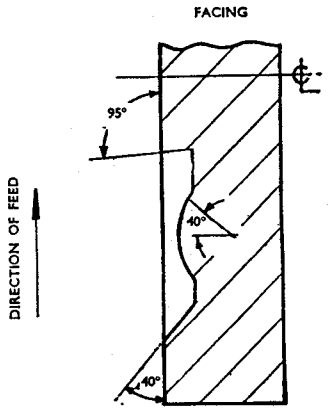


Fig. 8

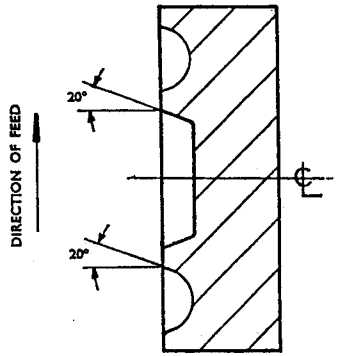


Fig. 9

Facing—Unit respectively at 30 degrees to and parallel with lathe axis

point. This arrangement relieves the operator of the need to withdraw the tool manually from critical undercuts, etc., at the end of the cut. Not only does this enable fast speeds to be used, but it also results in a corresponding improvement in finish.

General Performance

The quality of reproduction is determined by the accuracy of response from the copying unit and the accuracy of alignment of the axis of the workpiece to that of the model. Should the quality of work be unsatisfactory, the following notes give guidance as to possible sources of trouble and the corrective measures which should be applied.

(1) *Response Accuracy*

In principle, the copying mechanism is so designed that the hydraulic cylinder moves as nearly as possible in the exact path followed by the stylus. Valve movement required to produce change in the position of the cylinder must therefore be made as small as possible. (It is of interest to note that, in common with all servo mechanisms, the system is "error-operated" in that it depends on a difference occurring between the actual cylinder position and the position demanded by the model to produce valve deflection and consequent correcting movement of the cylinder.)

Should the unit be found to be faulty, a check should be made with the unit in a free state (i.e. tool not cutting) by means of a micrometer spindle which is rigidly clamped to the base slide. The end of this spindle contacts the stylus at an intermediate point in the stroke. At this point of contact a dial indicator from a fixed datum is set to the front of the tool slide.

The micrometer spindle enables small deflections to be applied to the valve and the response measured on the dial indicator. The unit must produce a definite response within a deflection of 0·0005 in., so that two distinct and separate movements can be observed within 0·001 in. deflection taken in backward and forward steps.

This check covers the overall assembly since it takes into account the internal alignment of the unit assembly and the tightness of the slide as well as the actual response characteristics of the hydraulic valve and cylinder, and also ascertains that the valve is not sticking.

2. *Mechanical Accuracy*

Having established that the unit is operating correctly, a check of model parallelism should be made in relation to a test bar between centres. Other general points to check are (*a*) that the tool radius is equal to the stylus radius, (*b*) that the stylus edge is vertical, and (*c*) that the stylus lever moves freely in its bearings without end play.

3. *Measuring Slide Friction*

In order to be able to check that the friction of the controlled slide is within permissible limits, a pressure gauge can be mounted in the rearmost of the two vents provided in the hydraulic cylinder.

Using a reliable 0-400 p.s.i. gauge, the copying system should be actuated by pulling back the stylus with gentle finger pressure until the slide moves through the full stroke of the cylinder. Reduction of finger pressure at the extent of the cylinder stroke will cause the slide to move slowly in the return direction.

At no time during the cylinder travel through its forward and return stroke should the variation in maximum and minimum gauge readings exceed 30 p.s.i.

Form Turning Limitations

Figures 6, 7, 8 and 9 show diagrammatically the limits on forms which can be turned in relation to the direction of feed indicated at the unit angles specified. The rate of longitudinal feed should be reduced slightly when turning reverse tapers or curves up to maximum angle, since the forward travel of the unit due to hydraulic stroke is in the same direction as the longitudinal feed.

Maintenance

A simple maintenance routine should be observed daily. The only requirements are that the slides should each be given a shot of oil through the nipples provided and that the oil

should be kept to indicator level. Shell Tellus 33 oil should be used for topping-up purposes and the level should not be allowed to fall more than $\frac{1}{4}$ in.

At approximately six-monthly intervals the pump unit should be removed from the oil tank and the suction filter cleaned. A replacement element should be fitted in the line filter and the oil renewed if it is noticeably dirty. *Air must be bled from the system after this operation.*

Abridged Specification

Cylinder bore	1·875 inch
Cylinder stroke	3 inches
System pressure at balance	300 p.s.i. (approximately)
Theoretical maximum stalled effort	414 lb.
Maximum diameter of model	$5\frac{1}{4}$ inches

Pump Set

Pump	Barnes PA 7100/A/20/CA/1
Motor	$\frac{1}{2}$ h.p., 1,440 r.p.m., flange mounted
Starter	Crabtree D.6 D.O.L. push-button type, fitted with thermal overload release
Suction filter	Purolator MP 3887
Line filter	Purolator MF 3915
Oil capacity	5 imperial gallons
Relief valve setting	325 p.s.i.

FAULTS—CAUSES AND REMEDIES

Inaccurate Reproduction	*Cause*	*Remedy*
(*a*) Unit fails to turn parallel	Malalignment of model or workpiece with axis of lathe	Check by means of test bar and correct
(*b*) Unit fails to climb shoulders	1. Overload due to depth of cut and/or tool rake (with positive rake)	Reduce cut or adjust tool rake
	2. Excessive length of stylus or loose stylus	Bring to $\frac{5}{8}$ in. length and/or tighten
	3. Longitudinal feed too fast	Reduce feed rate
(*c*) Unit "floats" away from model	Sticking valve or stylus lever	Remove valve spool, clean and replace with care
Erratic Performance	*Cause*	*Remedy*
(*d*) Slow or sluggish unit	1. Cold oil	Run pump set until working temperature of 100–120°F. (38–49°C.) is obtained
	2. Tight slide	Adjust
(*e*) Unit oscillates	1. Slide too free	Adjust slide strip
	2. Stylus or stylus lever loose	Tighten
	3. Air in hydraulic circuit	Bleed system

PARTS LIST

Part No.	Description	Quantity	Fig. No.
CYLINDER AND SLIDE			
C.16877	**Base slide**	1	11
	*Capscrew, $\frac{5}{16}$ in. U.N.C., $1\frac{1}{4}$ in. long	2	
	*Capscrew, $\frac{5}{16}$ in. U.N.C., $\frac{3}{4}$ in. long	2	
	*Supplied loose		
A.16880	**Ram thrust bracket**	1	
	Capscrew, $\frac{1}{4}$ in. U.N.C., $\frac{3}{4}$ in. long	4	
	Dowel, $\frac{1}{4}$ in. diameter, 1 in. long	2	
E.18784	**Profile slide**	1	
A.16878	**Profile slide strip**	1	
	Grubscrew, No. 10 U.N.C., $\frac{1}{2}$ in. long	4	
	Capscrew, $\frac{1}{4}$ in. U.N.C., $\frac{3}{4}$ in. long	4	
	Oil nipple, $\frac{1}{4}$ in. diameter	2	
S.15750	**Stop bar bracket**	1	10
S.15749	**Stop bracket**	1	
	Capscrew, $\frac{1}{4}$ in. U.N.C., $\frac{3}{4}$ in. long	4	
	Screwed bar, $\frac{5}{16}$ in. U.N.C., $5\frac{1}{2}$ in. long	1	
	Locknut, $\frac{5}{16}$ in. U.N.C.	2	
B.16890	**Ramshaft**	1	11
	Piston ring, $1\frac{7}{8}$ in. dia. $\times$ $\frac{1}{8}$ in.	2	
	Hexagon nut, $\frac{1}{2}$ in. U.N.C.	1	
	Plain washer, $\frac{1}{2}$ in.	1	
A.16879	**Ramshaft bearing bush**	1	
	O-ring, $1\frac{9}{16}$ in. $\times$ $1\frac{5}{16}$ in. $\times$ $\frac{1}{8}$ in.	1	
	O-ring, $1\frac{3}{4}$ in. $\times$ $1\frac{1}{2}$ in. $\times$ $\frac{1}{8}$ in.	1	
S.16896	**Bleed plug**	2	
	Seal (Dowty), $\frac{1}{4}$ in. diameter	2	
C.18785	**Port plate**	1	
	O-ring, $\frac{5}{16}$ in. $\times$ $\frac{7}{16}$ in. $\times$ $\frac{1}{16}$ in.	6	
	Capscrew, No. 10 U.N.C., 1 in. long	7	
	Capscrew, $\frac{1}{4}$ in. U.N.C. $\times$ $\frac{3}{4}$ in. long	2	
B.16891	**End plate**	1	
B.16895	**Gasket**	1	
	Capscrew, $\frac{1}{4}$ in. U.N.C., $\frac{5}{8}$ in. long	6	
A.18787	**Side cover plate**	1	10
	Screw, countersunk head, No. 10 U.N.C., $\frac{3}{8}$ in. long	4	
A.18801	**Valve cover**	1	
	Circlip B.R.40	1	
STYLUS LEVER ASSEMBLY			
B.18588	**Stylus lever**	1	11
A.18584	**Stylus lever shaft**	1	
A.18585	**Stylus**	1	
	Capscrew, $\frac{1}{4}$ in. U.N.C., $\frac{3}{8}$ in. long	1	
	Capscrew, $\frac{1}{4}$ in. U.N.C., 1 in. long	1	
A.18589	**Bearing shaft**	1	
	Angular contact bearing (Hoffmann) LSACD.7	1	
	Angular contact bearing (Hoffmann) A.12	1	
S.197771	**Locknut,** $\frac{1}{4}$ in. U.N.C.	1	
	Plain washer, $\frac{1}{4}$ in.	1	
	Grubscrew No. 4 U.N.C. $\times$ $\frac{1}{8}$ in. long	1	
S.18590	**Valve lever**	1	
	Locknut, $\frac{5}{16}$ in. U.N.C.	1	
S.18586	**Tappet screw**	1	

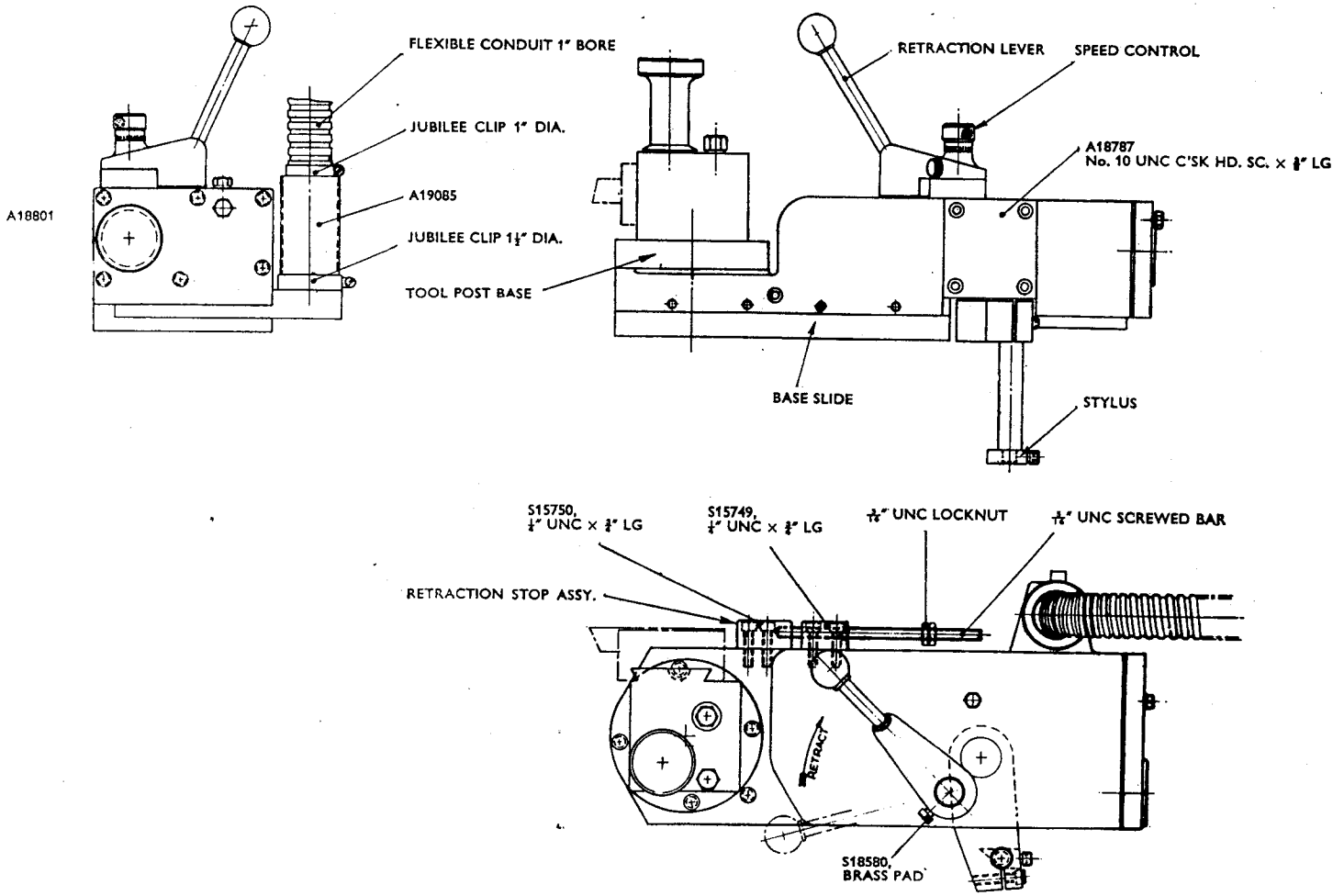


Fig. 10 Profile Unit (External)

Part No.	Description	Quantity	Fig. No.
S.18587	**Nut**	1	
A.18786	**Cover plate**	1	
	RETRACTION ASSEMBLY		
A.18556	**Cam**	1	
	Capscrew, No. 10 U.N.C., $\frac{5}{8}$ in. long	2	
A.18555	**Eccentric shaft (used only with speed control)**	1	
B.18579	**Retraction lever housing**	1	
S.18557	**Location peg**	1	
A.19856	**Compression spring**	1	
S.18580	**Locking screw**	1	10
	Brass pad, $\frac{3}{16}$ in. dia. × $\frac{5}{16}$ in. long	1	
S.18558	**Dial nut (used only with speed control)**	1	11
	Spring pin, $\frac{1}{8}$ in. dia. × $\frac{3}{4}$ in. long	1	
A.18559	**Lever handle**	1	
	Knob, 1 in. dia., tapped $\frac{3}{8}$ in. Whitworth	1	
	Locknut, $\frac{3}{8}$ in. U.N.C.	1	
	Spring pin, $\frac{1}{16}$ in. dia., $\frac{3}{8}$ in. long	1	
A.36464	**Eccentric shaft**		
	Spring pin, $\frac{1}{8}$ in. dia., $1\frac{1}{2}$ in. long	1	
	CARTRIDGE ASSEMBLY		
B.16946	**Cartridge (supplied complete only)**	1	11
	O-ring (Dowty), 1 in. outside diameter P.P.130 Mk. 8, List 5	5	
	Screws, round-headed, No. 4 U.N.C., $\frac{3}{8}$ in. long	4	
	TOOLBOX ASSEMBLIES. "Chipmaster" Model		
C.22083	**Toolbox assembly**		
B.22090	**Toolpost base**	1	12
	*Capscrew $\frac{1}{4}$ in. U.N.C. × $\frac{5}{8}$ in. long	3	
	*Supplied loose		
C.22084	**Body (vertical lock only)**	1	
	Oil nipple $\frac{1}{4}$ in. dia.	5	
A.22149	**Handfeed bearing**	1	
	Grubscrew $\frac{1}{4}$ in. U.N.C. × $\frac{3}{8}$ in. long-cone point	1	
A.22086	**Spiral gear shaft**	1	
	Spring pin $\frac{1}{8}$ in. dia. × $1\frac{1}{8}$ in. long	1	
A.22148	**Adjusting cap**	1	
A.22087	**Locking pad (vertical lock only)**	1	
	Steel ball $\frac{3}{16}$ in. dia.	1	
A.22085	**Lockbolt (vertical lock only)**	1	
25098	**Clamp bolt**	2	
25096	**Clamp pad**	2	
25100	**Spring**	2	
C.31230	**Toolbox body (side clamping lock)**	1	
A.31231	**Clamp bolt (side clamping lock)**	1	
A.31235	**Clamp nut (side clamping lock)**	1	
S.31236	**Washer (side clamping lock)**	1	
	"STUDENT" and "TRIUMPH" MODELS		
C.21784/A/B	**Toolbox assembly**		
B.32359	**Toolpost base, steel (Student)**	1	
	Capscrew $\frac{1}{4}$ in. U.N.C. × $\frac{7}{8}$ in. long (Student)	3	
B.32358	**Toolpost base, steel (Triumph)**	1	
	Capscrew $\frac{1}{4}$ in. U.N.C. × 1 in. long (Triumph)	3	

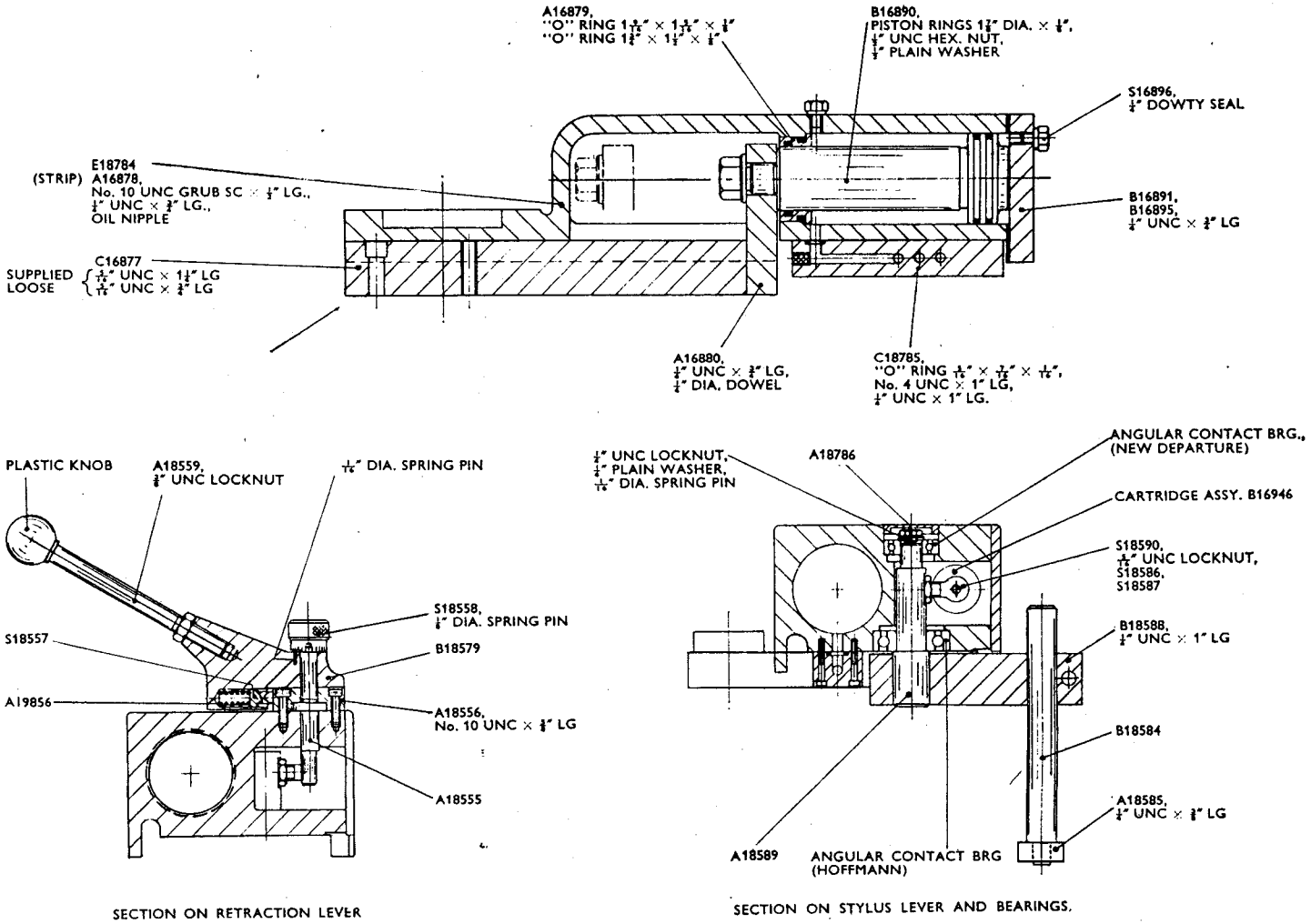


Fig. 11

Sectional Arrangement of Profile Unit

Part No.	Description	Quantity	Fig. No.
C.21785	**Body (vertical lock only)**	1	
	Oil nipple $\frac{1}{4}$ in. dia.	5	
A.21813	**Handfeed bearing**	1	
	Grubscrew $\frac{1}{4}$ in. U.N.C. × $\frac{1}{2}$ in. long-cone point ...	1	
A.18973	**Spiral gear shaft**	1	
	Spring pin $\frac{1}{8}$ in. dia. × $\frac{1}{2}$ in. long	1	
A.21817	**Adjusting cap**	1	
A.18976	**Locking pad (vertical lock only)**	1	
	Steel ball $\frac{3}{16}$ in. dia.	1	
A.21816	**Lockbolt (vertical lock only)**	1	
25099	**Clamp bolt**	2	
25097	**Clamp pad**	2	
25101	**Spring**	2	
C.31016	**Tool box body, (side clamping)**	1	
A.30715	**Lock bolt**	1	
A.30716	**Clamp nut**	1	
S.30718	**Washer**	1	
	"CHIPMASTER", "STUDENT" and "TRIUMPH" MODELS		
A.21810	**Leadscrew**	1	
A.17768	**Spiral gear**	1	
	Spring pin $\frac{1}{8}$ in. dia. × $\frac{1}{2}$ in long	1	
A.21811	**Leadscrew nut**	1	
	Capscrew No. 10 U.N.C. × $\frac{5}{8}$ in. long	2	
A.21812	**Thrust bearing**	1	
	Screws round head No. 6 U.N.C. × $\frac{3}{8}$ in. long	2	
S.18470	**Leadscrew locknut**	1	
S.19031	**Toolbox strip**	1	
	Grubscrew No. 10 U.N.C. × $\frac{5}{8}$ in. long—full dog point	2	
	BEAM AND TAILSTOCKS ASSEMBLY		
E.18695	**Beam and tailstocks assembly, complete**		
D.18795/A	**Beam,** 29 in. long	1	13
D.18795/B	**Beam,** 31 in. long	1	14
D.18795/C	**Beam,** 38$\frac{1}{2}$ in. long	1	
D.18795/D	**Beam,** 51 in. long	1	
D.18795/E	**Beam,** 43 in. long	1	
D.18795/F	**Beam,** 37 in. long	1	
D.18795/G	**Beam,** 55 in. long	1	
D.18795/H	**Beam,** 65 in. long	1	
D.18795/J	**Beam,** 47 in. long	1	
	Capscrew, $\frac{1}{4}$ in. U.N.C., 1 in. long, for "Chipmaster" model	6	13
	Capscrew, $\frac{1}{4}$ in. U.N.C., 1 in. long, for "Student" and "Triumph" models	8	14
C.20135	**Beam bracket,** right-hand, for "Chipmaster" model ...	1	13
C.20135/1	**Beam bracket,** left-hand, for "Chipmaster" model ...	1	
C.20134	**Beam bracket,** right-hand, for "Student" and 'Triumph" models	1	14
C.20134/1	**Beam bracket,** left-hand, for "Student" and "Triumph" models	1	
A.18792	**Clamp bolt** for "Chipmaster" model	2	13
A.17696	**Clamp bolt** for "Student" and "Triumph" models ...	2	14
A.17697	**Bearing washer**	2	13 & 14
	Disc spring (Schnorr)	2	
	Plastic handwheel (Rencol), 3 in. dia.	2	

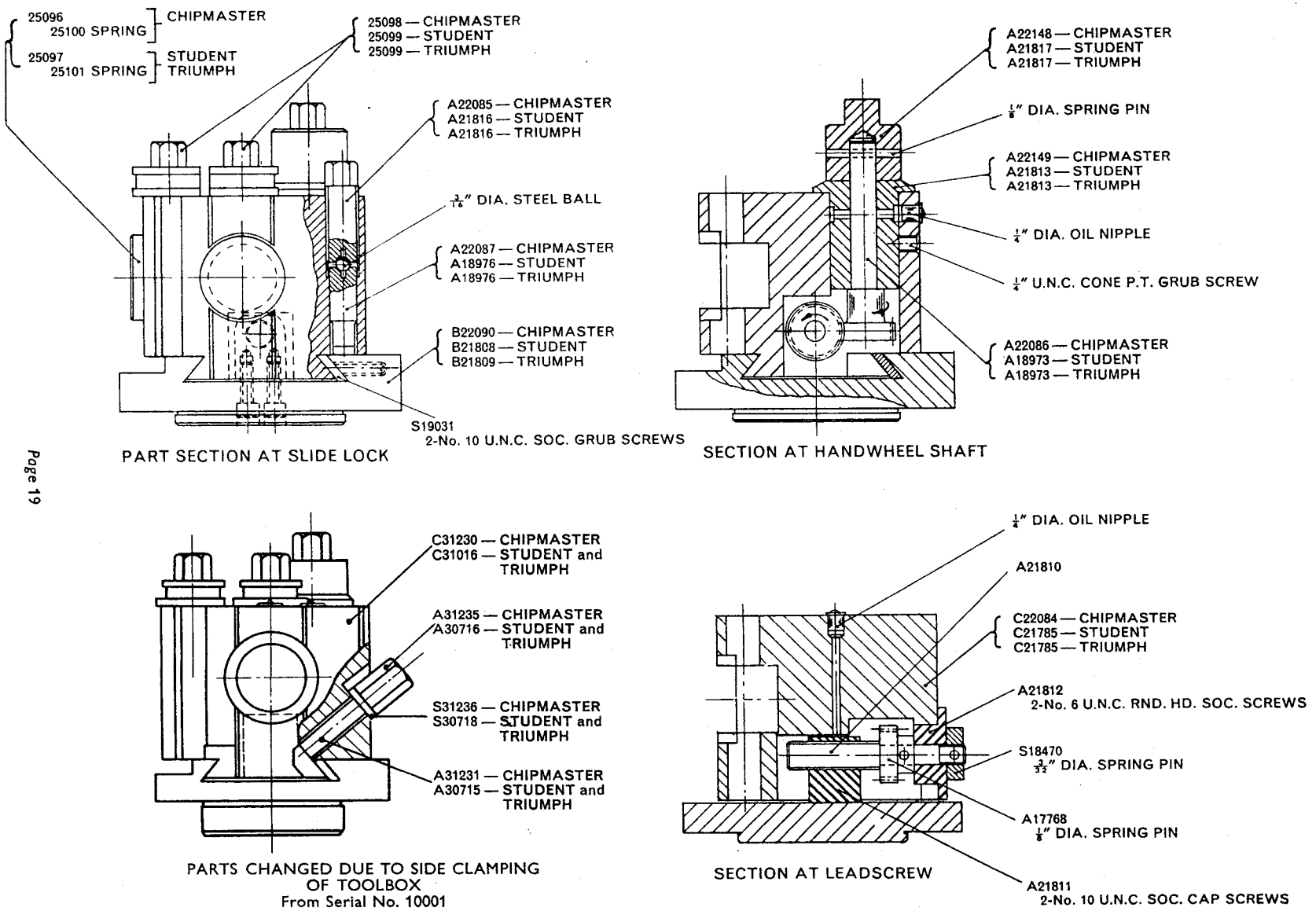
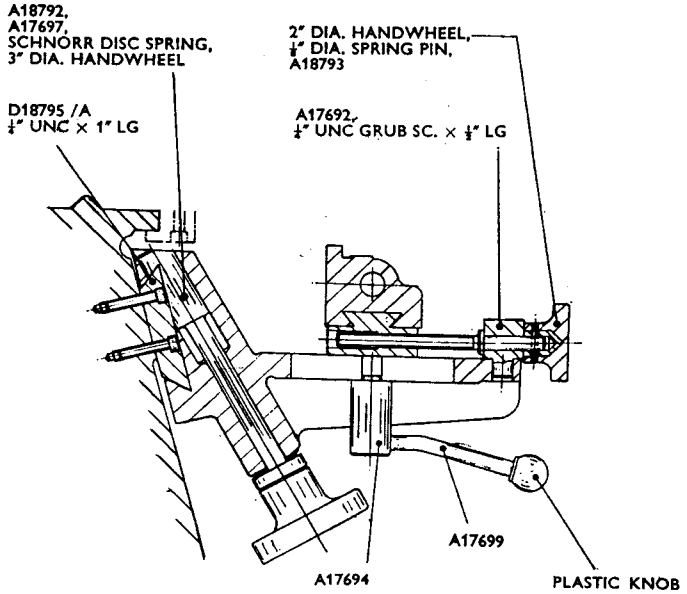


Fig. 12 INTERCHANGEABLE TOOLBOX (fitted as Standard after Serial No. C4800)

Part No.	Description	Quantity	Fig. No.
ADJUSTABLE TAILSTOCK			
B.17688	**Model carrier base**	1	15
A.17693	**Stud**	1	
A.17694	**Nut**	1	13 & 14
A.17699	**Handle**	1	
	Plastic knob, $1\frac{1}{4}$ in. diameter, tapped $\frac{3}{8}$ in. Whitworth ...	1	
A.17692	**Bearing nut**	1	
	Grubscrew, $\frac{1}{4}$ in. U.N.C., $\frac{1}{2}$ in. long	1	
A.19947	**Leadscrew**	1	
	Plastic handwheel (Rencol), 2 in. dia. × 4 in. bore ...	1	
	Spring pin, $\frac{1}{16}$ in. diameter, 1 in. long	1	
B.17689	**Model carrier,** adjustable	1	15
	Morse taper centre No. 1	1	
A.17690	**Thrust plate**	1	
	Capscrew, $\frac{1}{4}$ in. U.N.C., $\frac{5}{8}$ in. long	3	
A.20019	**Leadscrew**	1	
	Plastic handwheel (Rencol), 2 in. dia. × $\frac{3}{8}$ in. bore ...	1	
	Spring pin, $\frac{1}{8}$ in. diameter, 1 in. long	1	
SPRING TAILSTOCK			
B.17701	**Model carrier**	1	15
A.17693	**Stud**	1	
A.17694	**Nut**	1	13 & 14
A.17699	**Handle**	1	
	Plastic knob, $1\frac{1}{4}$ in. diameter, tapped $\frac{3}{8}$ in. Whitworth ...	1	
A.18548	**Spring centre**	1	15
	Circlip (Anderton), $\frac{1}{2}$ in. external	1	
S.18577	**Spring**	1	
S.18549	**End plate**	1	
	Capscrew, No. 6, U.N.C., $\frac{1}{2}$ in. long	4	
	Capscrew, $\frac{1}{4}$ in. U.N.C., $\frac{5}{8}$ in. long (Template)	4	
PIPES AND FITTINGS			
S.19032	**Flexible tube fittings,** $\frac{1}{4}$ in. bore	4	16
S.19033	**Flexible tube fittings,** $\frac{5}{32}$ in.	2	
	Nylon flexible tube, $\frac{5}{16}$ in. o.d.	2	
	Nylon flexible tube, $\frac{3}{32}$ in. o.d.	1	
A.19085	**Pipe adaptor**	2	10 & 16
	Flexible conduit, 1 in. bore	1	
	Jubilee clip, $1\frac{1}{2}$ in. diameter	2	
	Jubilee clip, 1 in. diameter	2	
	Seal (Dowty), $\frac{1}{8}$ in. B.S.P.	6	
HYDRAULIC POWER UNIT			
D.10183	**Tank**	1	16
C.18737	**Tank lid**	1	
A.18738	**Pipe entry adaptor**	1	
	Bolt, $\frac{5}{16}$ in. U.N.C., hexagon headed, $\frac{3}{4}$ in. long	3	
A.19311	**Pressure gauge union**	1	
	Plug, $\frac{1}{4}$ in. B.S.P.	1	
C.18796	**Pump and motor bracket**	1	
	Bolt, $\frac{5}{16}$ in. U.N.C., hexagon headed, $\frac{3}{4}$ in. long	4	
	Plain washer, $\frac{5}{16}$ in.	4	
	Renold flexible coupling	1	
	Motor, flange mounted, $\frac{1}{2}$ h.p., 1,440 r.p.m.	1	
	Bolt, $\frac{5}{16}$ in. U.N.C., hexagon headed, $\frac{3}{4}$ in. long	4	



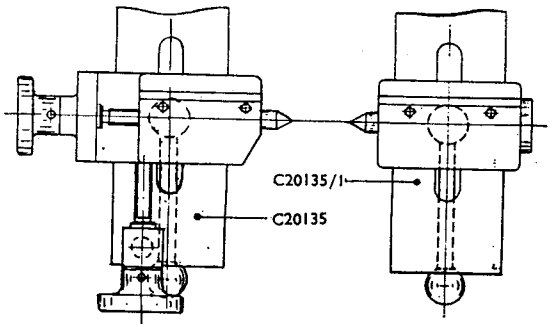
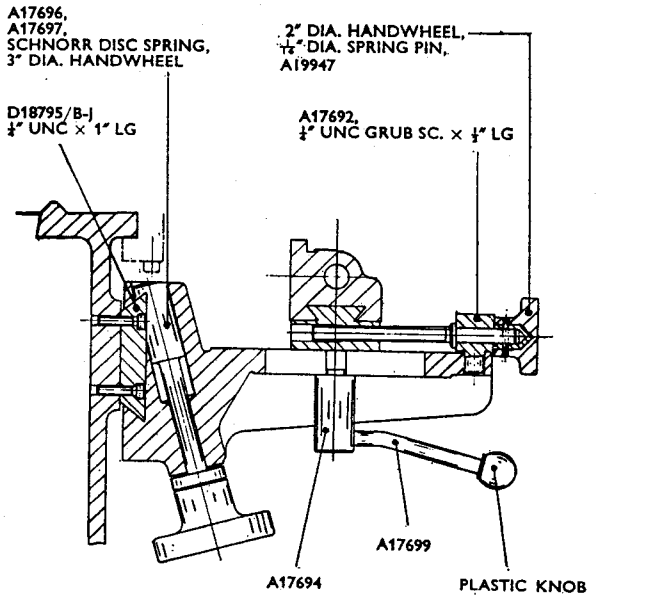


Fig. 13 Tailstocks "Chipmaster" Model



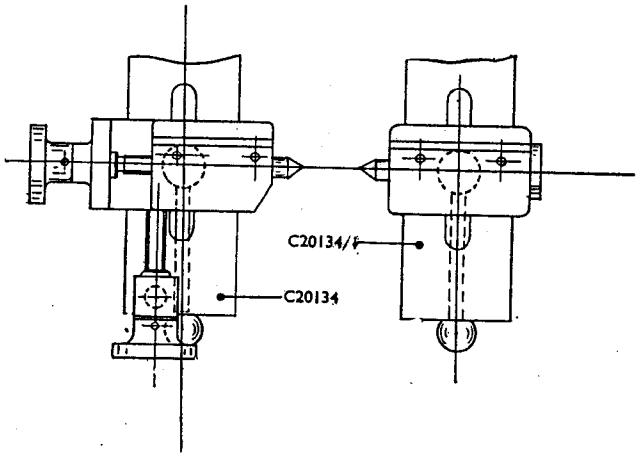


Fig. 14 "Student" and "Triumph" Models

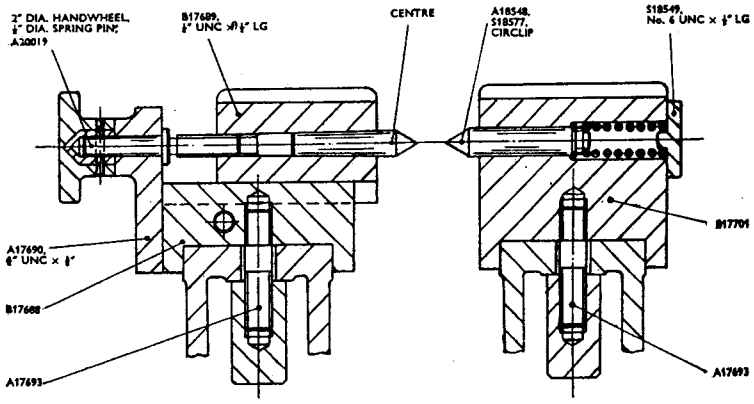


Fig. 15

Model Carriers

Part No.	*Description*	*Quantity*	*Fig. No.*
	Pump (Barnes PA 7100/A/20/CA/1)	1	
	Bolt, $\frac{5}{16}$ in. U.N.C., hexagon headed, $\frac{3}{4}$ in. long	4	
	Plain metal filter (Purolator MP 3887)	1	
	Suction pipe	1	
	Nut, $\frac{3}{8}$ in. B.S.P.	1	
	Nipple, $\frac{3}{8}$ in. B.S.P.	1	
S.10192	**Filter nut**	1	
S.18843	**Adaptor,** $\frac{1}{2}$ in. N.P.T.F. (taper) × $\frac{3}{8}$ in. B.S.P.	2	
A.18844	**Relief valve union**	1	
	Relief pipe	1	
	Nut, $\frac{3}{8}$ in. B.S.P.	1	
	Nipple, $\frac{3}{8}$ in. B.S.P.	1	
A.19309	**Two-way junction**	1	16
	Micronic oil filter (Purolator MF 3915)	1	
	Bolt, $\frac{3}{8}$ in. U.N.C., hexagon headed, $\frac{3}{4}$ in. long	2	
	Nut, $\frac{3}{8}$ in. U.N.C.	2	
	Plain washer, $\frac{3}{8}$ in.	2	
A.19310	**Filter adaptor**	2	16
	Brass filler cap	1	
	Gauze strainer...	1	
	Oil window	1	
C.10186	**Starter holder**	1	16
S.10193	**Adaptor stud**	4	
	Starter (Crabtree type D.6)	1	
	Screw, round headed, No. 10 U.N.C., $\frac{1}{2}$ in. long	2	
	Flexible conduit, $\frac{1}{2}$ in., 12 in. long	1	
	Flexible conduit adaptor, $\frac{1}{2}$ in.	2	
	P.V.C. cable (green) 7 × ·029 in., 20 in. long	1	
	P.V.C. cable (black) 7 × ·029 in., 20 in. long	2	
S.9039	**Nameplate**	1	16
	Grooved stud (Mills), $\frac{3}{16}$ in. × $\frac{3}{16}$ in.	4	

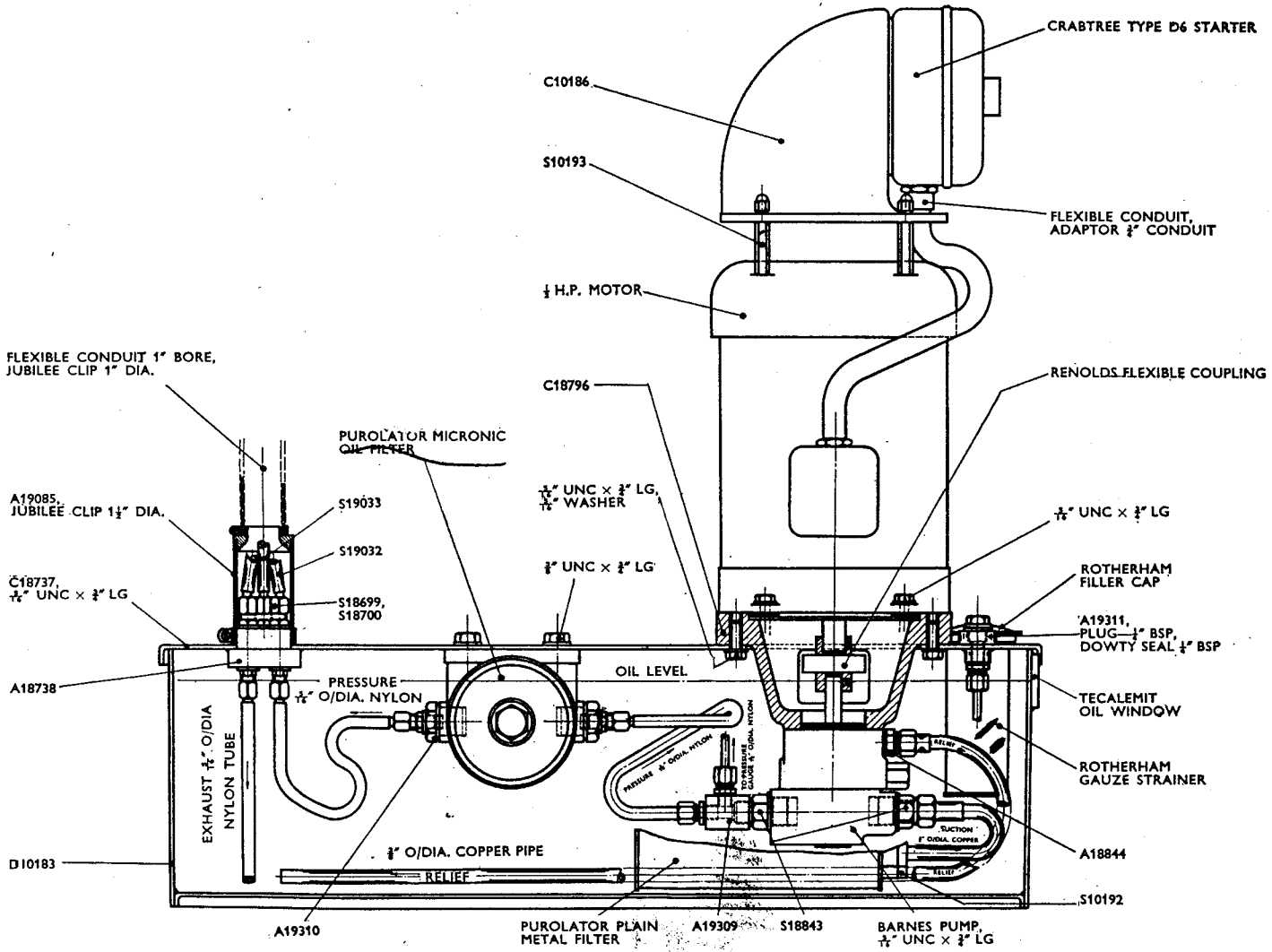


Fig. 16

Power Unit

Part No.	Description	Quantity	Fig. No.
	No. 4 U.N.C. × $\frac{1}{4}$ in. long capscrew	1	
S.19946	**Ratchet spring**	1	
S.1879	**Spring**	1	
A.20646	**Lever Boss**	1	
	$\frac{1}{8}$ in. dia. spring pin × $1\frac{1}{2}$ in. long	1	
	Sel-lok pin, $\frac{5}{32}$ in. dia. × $\frac{7}{8}$ in. long...	1	
	Grubscrew, No. 10 U.N.C. × $\frac{1}{2}$ in. long	1	
A.20652	**Retraction handle**	1	
	1 in. dia. Whiteley plastic knob	1	
S.20870	**Stop pegs**	3	
	No. 10 U.N.C. × $\frac{1}{2}$ in. long grubscrew	1	
TURRET STOP			
B.20641	**Turret stop assembly**	–	17
B.20642	**Turret housing**	1	
	No. 10 U.N.C. × $\frac{1}{2}$ in. long capscrews	4	
	Sel-lok spring pin, $\frac{3}{16}$ in. dia. × $\frac{3}{4}$ in. long	2	
A.20645	**Turret bearing**	1	
	No. 10 U.N.C. × $\frac{1}{2}$ in. long capscrews	2	
B.20643	**Turret**	1	
A.20644	**Ratchet**	1	
S.15510	**Turret Stops**	1 set	
S.20567	**Plunger**	1	
S.1109	**Spring**	1	
	No. 10 U.N.C. locknuts	6	
A.19896	**Turret-operator**	1	

Note: The serial number of the equipment should be quoted in any correspondence.

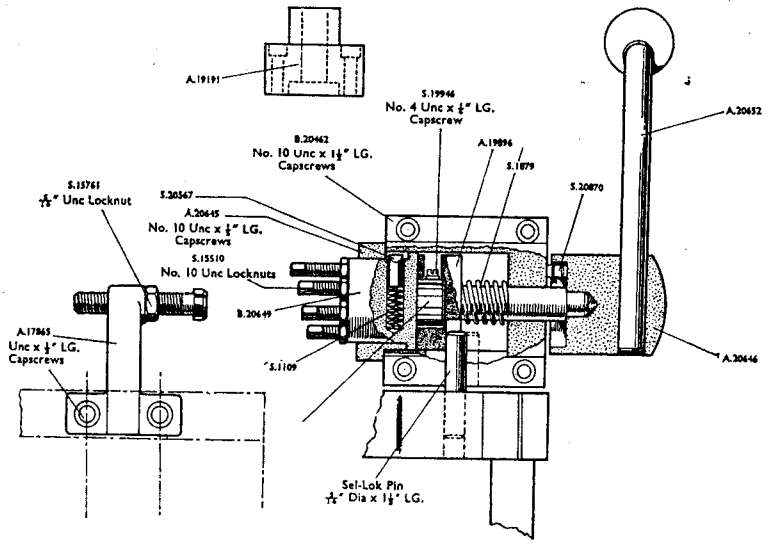


Fig. 17 Turret Stop

Part No.	Description	Quantity	Fig. No.
Additional equipment for use with turret stop			
A.17865	**Stop bracket**	1	
	Capscrew, $\frac{1}{4}$ in. U.N.C., $\frac{1}{2}$ in. long	2	
S.15761	**Retraction stop**	1	
	Locknut, $\frac{5}{16}$ in. U.N.C.	1	
	Sel-lok pin, $\frac{1}{16}$ in. dia. $\times$ $\frac{3}{8}$ in. long...	1	
S.18699	**Flexible tube fittings**	5	16
S.18700	**Flexible tube fittings**	2	
	Flexible nylon tube, $\frac{5}{16}$ in. o.d., 30 in. long	–	
	Flexible nylon tube, $\frac{3}{16}$ in. o.d., 18 in. long	–	
	Seal (Dowty), $\frac{1}{2}$ in. B.S.P.	4	
	Seal (Dowty), $\frac{3}{8}$ in. B.S.P.	1	
	Seal (Dowty), $\frac{1}{4}$ in. B.S.P.	2	
	Seal (Dowty), $\frac{1}{8}$ in. B.S.P.	10	
	Fibre washer, $\frac{1}{4}$ in. B.S.P.	2	