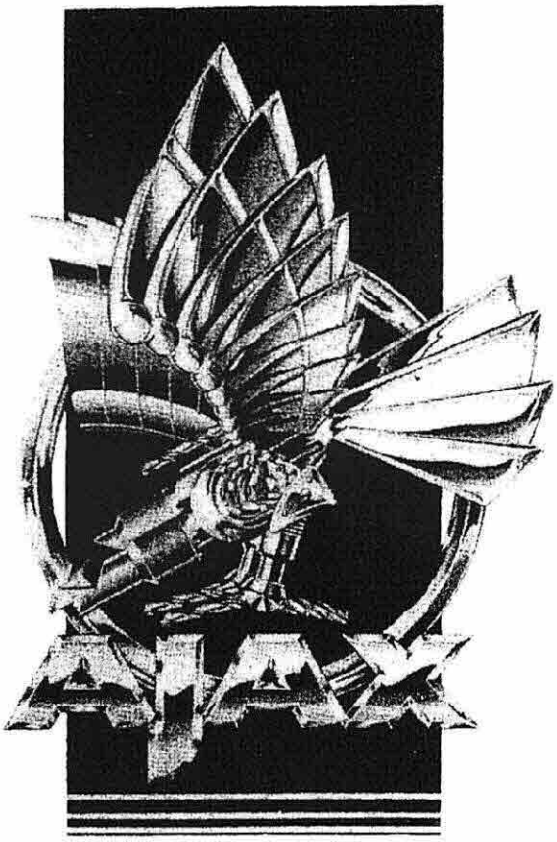


No.2, No.3 & No.4

CLEVELAND UNIVERSAL MILLING MACHINES

Installation, Operating, Maintenance and Spare Parts Manual

Index

Continued

INDEX (Continued)

Procedure for Ordering Spare Parts

Along with this INSTALLATION OPERATING AND MAINTENANCE MANUAL which serves for all three Models of CLEVELAND UNIVERSAL MILLING MACHINES a separate SPARE PARTS MANUAL is also supplied which relates to the particular Model of Machine purchased. This SPARE PARTS MANUAL contains a series of Plates showing sectional drawings of sub-assemblies of the various units of the machine. On these Plates each part is numbered and consequently the required Part or Parts can be identified by Part Number and Plate Number.

WHEN ORDERING SPARE PARTS PLEASE QUOTE:—

1) Model Number of Machine — i.e. No. 2, No. 3 or No. 4 Ajax Cleveland Universal Milling Machine.

2) Serial Number of Machine — This Number will be found on the Ajax Serial Number Plate affixed to the large cover at the rear of the machine.

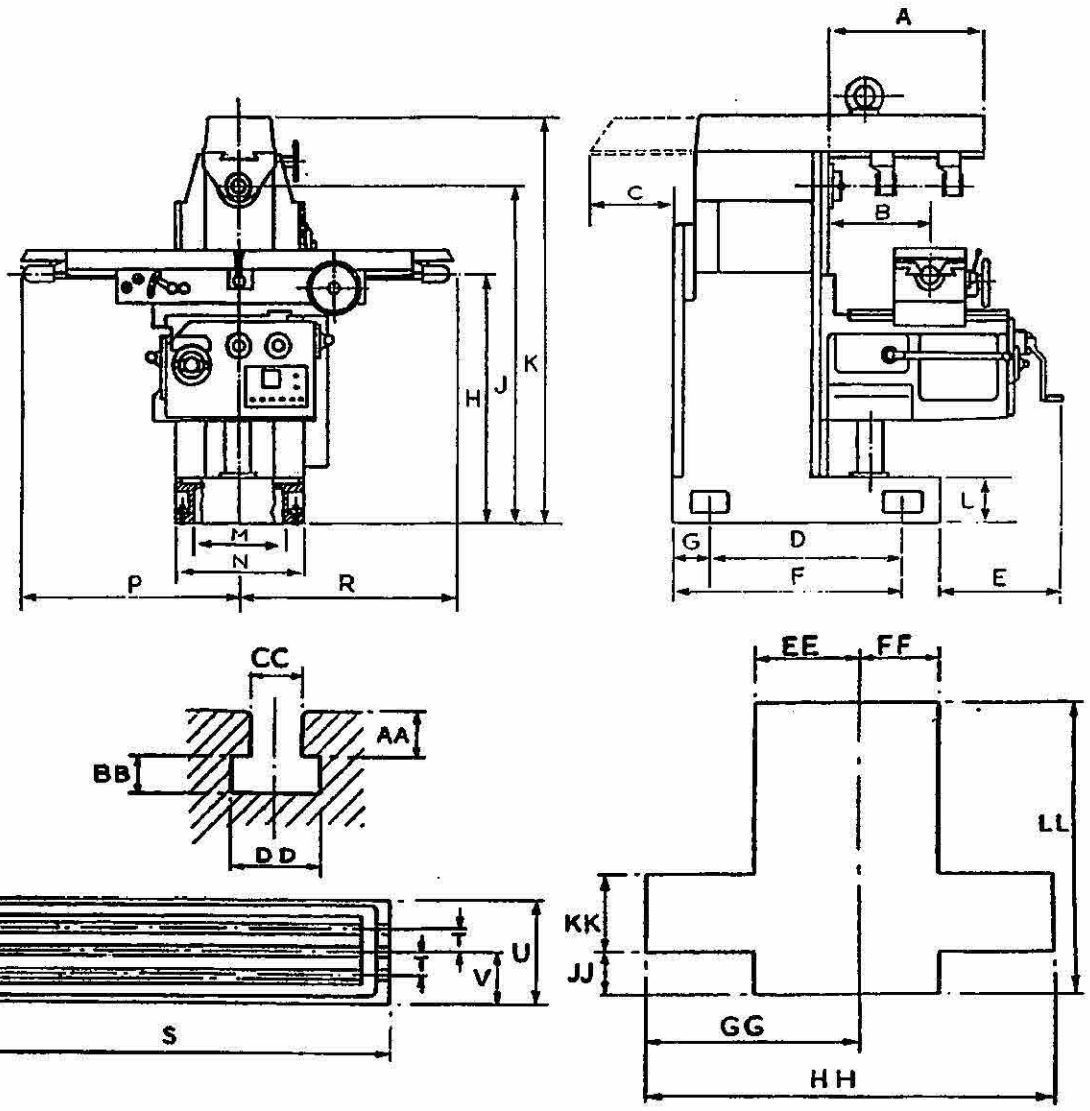
3) (a) Part Number and (b) corresponding Plate Number — as identified from separate SPARE PARTS MANUAL.

4) State whether Machine is calibrated to the Imperial or Metric System of Measurement.

Although the information given in this manual was correct at the time of printing, we are constantly working to improve the performance of the machines we produce and consequently reserve the right to make alterations to design and specification without notice.

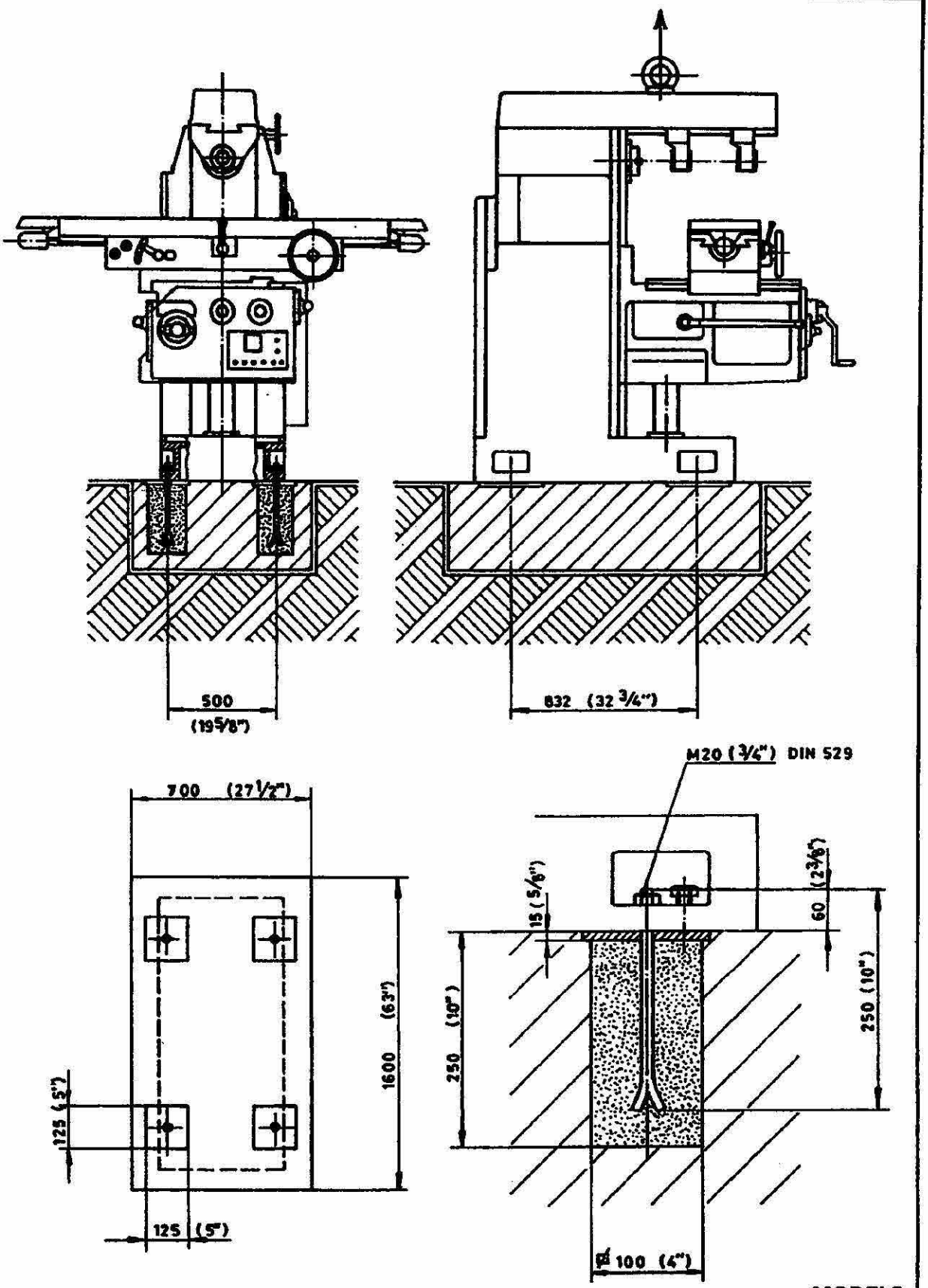
Specification

	No. 2 Ajax Universal Milling Machine		No. 3 Ajax Universal Milling Machine		No. 4 Ajax Universal Milling Machine	
TABLE						
Working surface	55 × 13⅜"	1400 × 340mm	63 × 13⅜"	1600 × 340mm	72 × 13¾"	1800 × 350mm
T-slots, number and size	3 × 45/64"	3 × 18mm	3 × 45/64"	3 × 18mm	3 × 45/64"	3 × 18mm
T-slots centres	3 9/32"	80mm	3 9/32"	80mm	3 9/32"	80mm
Swivel movement	90° inclusive		90° inclusive		90° inclusive	
RANGE OF TABLE						
Longitudinal automatic	41¼"	1047mm	46¾"	1186mm	52⅜"	1330mm
Longitudinal manual	42"	1067mm	47½"	1206mm	53"	1350
Cross automatic	12⅝"	320mm	14 3/16"	360mm	14 3/16"	360mm
Cross manual	13"	330mm	14½"	370mm	14½"	370mm
Vertical automatic	17 1/16"	440mm	18⅝"	473mm	18⅝"	473mm
Vertical manual	17¾"	450mm	19"	483mm	19"	483mm
Maximum distance from centre of spindle to table	17¾"	450mm	19"	483mm	19"	483mm
SPINDLE						
Taper ISO	No. 50	No. 50	No. 50	No. 50	No. 50	No. 50
Arbor diameter	1"	25.4mm	1¼"	32mm	1¼"	32mm
Number of speeds	18	18	18	18	18	18
Speed range	28 – 1400 rpm		28 – 1400 rpm		28 – 1400 rpm	
FEEDS						
Number of Feeds	12		12		12	
Longitudinal	⅜ – 25"/min	10 – 650mm/min	⅜ – 25"/min	10 – 650mm/min	⅜ – 25"/min	10 – 650mm/min
Cross	⅜ – 25"/min	10 – 650mm/min	⅜ – 25"/min	10 – 650mm/min	⅜ – 25"/min	10 – 650mm/min
Vertical	⅛ – 7¾"/min	3 – 195mm/min	⅛ – 7¾"/min	3 – 195mm/min	⅛ – 7¾"/min	3 – 195mm/min
RAPID TRAVERSE						
Longitudinal	118"/min	3000mm/min	118"/min	3000mm/min	118"/min	3000mm/min
Cross	118"/min	3000mm/min	118"/min	3000mm/min	118"/min	3000mm/min
Vertical	35½"/min	900mm/min	35½"/min	900mm/min	35½"/min	900mm/min
MOTORS						
Spindle Drive Motor	6 hp		12 hp		15 hp	
Feed Drive Motor	1½ hp		2 hp		2½ hp	
Coolant Motor	⅛ hp		⅛ hp		⅛ hp	
WEIGHT						
Nett weight approximately	4,650lbs	2150kg	6,380lbs	2900kg	8,910lbs	4050kgs
Gross weight approximately	5,500lbs	2500kg	6,820lbs	3,100kg	10,230lbs	4650kg
Shipping case size (length × height × width)	78 × 72 × 78"	1.98 × 1.9 × 1.98m	73 × 77 × 71"	2.13 × 1.98 × 2.13m	73 × 77 × 71"	2.13 × 1.98 × 2.13m
Volume	254 cu.ft	7.5 cu.m	231 cu.ft.	9 cu.m	231 cu.ft.	9 cu.m



		A	B		C	D	E	F	G	H		J	K	L	M	N	
			Min	Max						Min	Max						Min
No. 2	Inches	30	9½	22⅜	17¾	32¾	16¼	52⅜	10⅛	40½	58¼	58¼	73⅜	8⅝	19⅝	22⁷⁄₁₆	22¹³⁄₁₆
	mm	760	240	570	400	832	414	1330	258	1030	1480	1480	1812	220	500	570	580
No. 3	Inches	29⅛	8⅝	23¼	21⅞	32¾	17⁹⁄₁₆	52⅜	10⅛	40¼	59¼	59¼	73	8⅝	19⅝	22⅞	25
	mm	740	220	590	545	832	447	1330	258	1022	1505	1505	1855	220	500	570	636
No. 4	Inches	29⅛	9¼	23⅞	21⅞	32¾	17⁹⁄₁₆	52⅜	10⅛	40¼	59¼	59¼	73	8⅝	19⅝	22⁷⁄₁₆	28⁹⁄₁₆
	mm	740	235	605	545	832	447	1330	258	1022	1505	1505	1855	220	500	570	726

		R		S	T	U	V	AA	BB	CC	DD	EE	FF	GG	HH	JJ	KK
		Min	Max														
No. 2	Inches	20⁹⁄₁₆	62⁹⁄₁₆	55⅛	3³⁄₃₂	13⅜	6¹¹⁄₁₆	⁴⁵⁄₆₄	⁹⁄₁₆	⁴⁵⁄₆₄	1¼	15¾	16⁵⁄₃₂	64¹³⁄₁₆	127⁷⁄₁₆	10¾	30½
	mm	523	1590	1400	80	340	170	18	14	18	32	400	410	1647	3237	273	775
No. 3	Inches	20¾	68¼	63	3³⁄₃₂	13⅜	6¹¹⁄₁₆	⁴⁵⁄₆₄	⁹⁄₁₆	⁴⁵⁄₆₄	1¼	16¹⁵⁄₁₆	17¹⁷⁄₃₂	72½	140²⁵⁄₃₂	10⁹⁄₁₆	30²³⁄₃₂
	mm	528	1734	1600	80	340	170	18	14	18	32	430	445	1842	3576	268	780
No. 4	Inches	26½	79⅝	70⅞	3³⁄₃₂	13¾	6²⁹⁄₃₂	⁴⁵⁄₆₄	⁹⁄₁₆	⁴⁵⁄₆₄	1¼	16¹⁵⁄₁₆	17¹⁷⁄₃₂	81¾	161½	10³⁄₃₂	31³⁄₃₂
	mm	674	2024	1800	80	350	175	18	14	18	32	430	445	2076	4100	258	790



LIFTING & FOUNDATION DETAILS

Fig. 1

MODELS
No. 2, No. 3 & No. 4

MACHINES No. 2, No. 3 & No. 4 (LH VIEW)

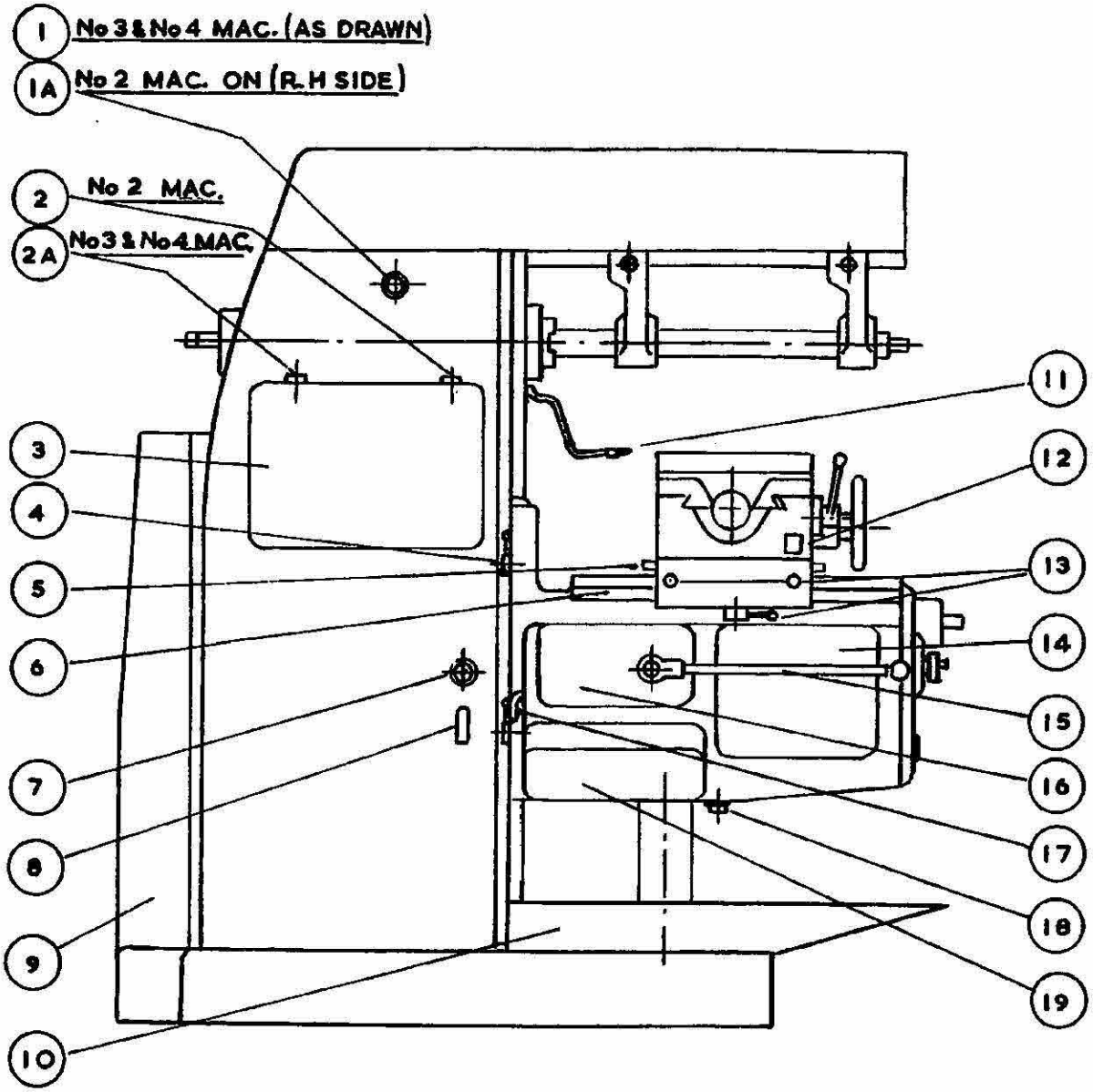


Fig. 2 MODELS
No. 2, No. 3 & No. 4

Key to Fig. 2 (left hand view)

1	Oil sight glass (Column) No. 3 & No. 4 Machines (as drawn)
1A	Oil sight glass (Column) No. 2 Machine (on RH side)
2	Oil filler plug (Main spindle gearbox) No. 2 machine
2A	Oil filler plug (Main spindle gearbox) No. 3 & No. 4 machines
3	Inspection cover (Main spindle gearbox)
	Vertical slide locking lever (two)
	Table swivel locking screw
	Saddle slideway
	Oil level sight glass (Main spindle gearbox)
	Oil drain plug (Main spindle gearbox)
9	Rear cover
10	Splash guard
11	Coolant pipe and adjustable nozzle
12	"One Shot" Lubrication unit
13	Cross slide locking lever (Normal duty)
	Cross slide locking screws (two) (heavy duty)
14	Feed gearbox cover
15	Rapid traverse and normal feed lever
16	Clutch adjustment cover
17	Oil drain plug (Clutch compartment)
18	Oil drain plug (knee)
19	Power feed and rapid traverse motor compartment.

MACHINES No. 2, No. 3 & No. 4
RIGHT HAND VIEW

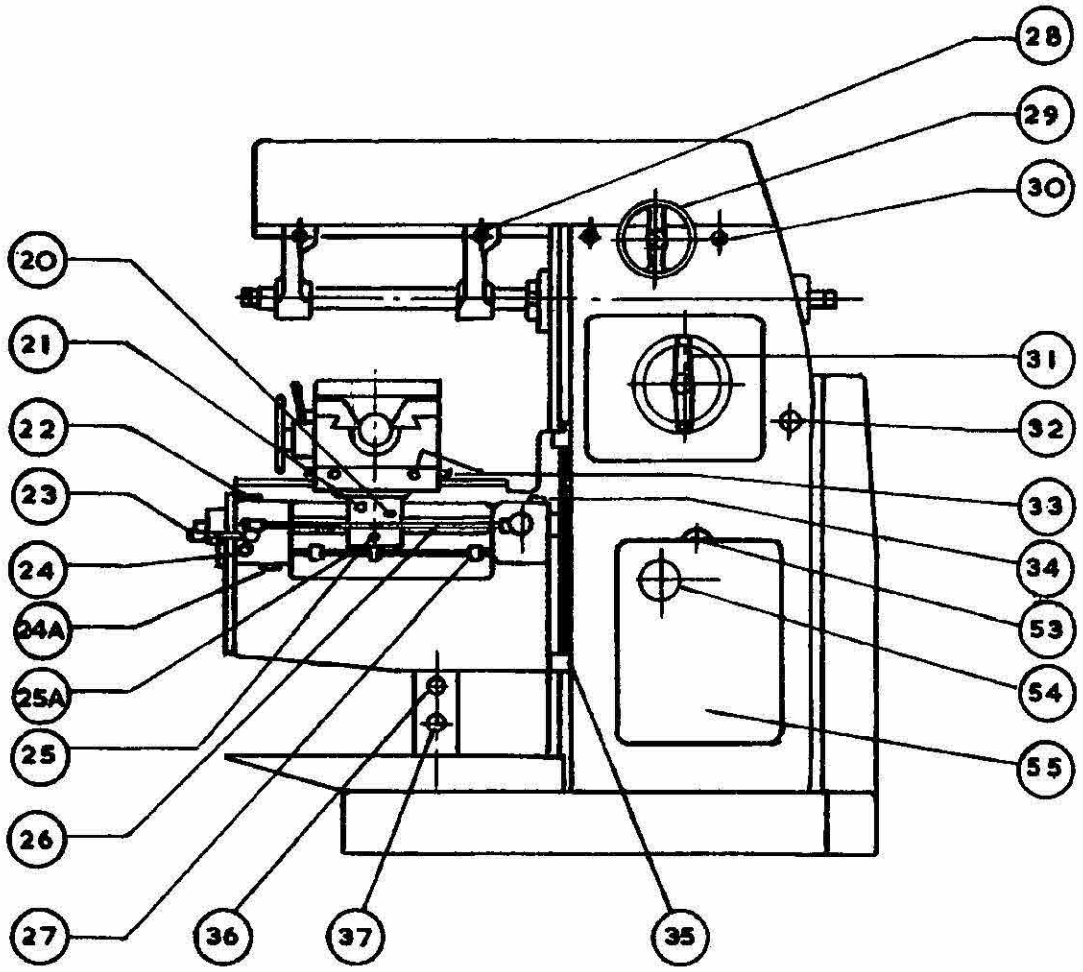


Fig. 3 MODELS
No. 2, No. 3 & No. 4

Key to Fig. 3 (right hand view)

20	Oil level sight glass (Cross traverse screw)
21	Oil filler plug (Cross traverse screw)
22	Oil filler plug (Bevel gear box)
23	Cross feed lever
24	Oil level sight glass (Bevel gear box)
24A	Oil drain plug (Bevel gear box)
25	Push button (Lubrication to cross screw & nut)
25A	Oil drain plug (Cross screw & Nut housing)
26	Vertical traverse feed lever
27	Cross traverse trip bar and stops
28	Arbor support bracket locknuts
29	Handwheel adjustment to overarm (Not fitted to no. 2 machine)
30	Overarm locking nuts
31	Spindle speed change handle and dial
32	Inching button
33	Table swivel locking screws (4) one at front, one at rear, and two at the RH end face of saddle
34	Oil filler plug (Knee)
35	Vertical traverse trip stops
36	Oil filler plug } Lubrication to vertical screw and nut
37	Oil level sight glass } Lubrication to vertical screw and nut
53	Mains indicator light (Red)
54	Mains on/off isolating switch
55	Mains electrical panel.

MACHINES No. 2, No. 3 & No. 4
FRONT VIEW

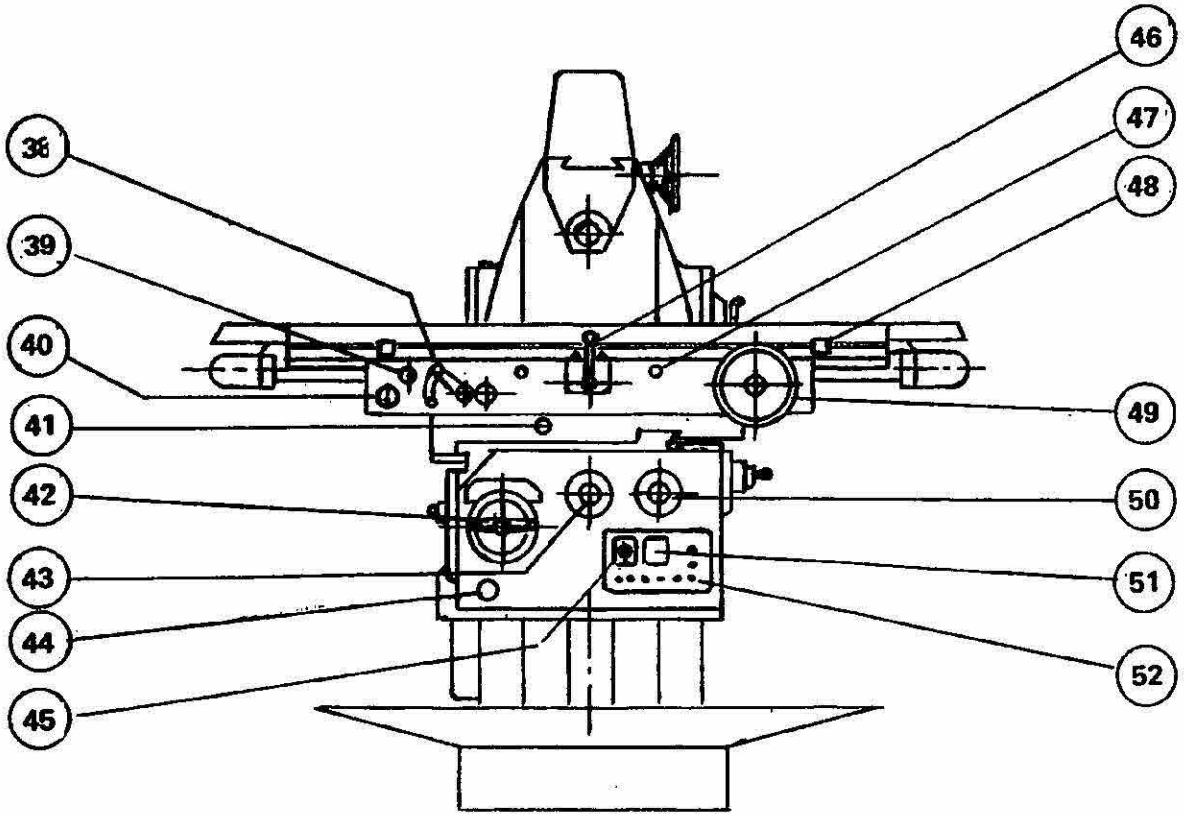


Fig. 4 MODELS
No. 2, No. 3 & No. 4

Key to Fig. 4 (Front View)

38. Backlash Eliminator Controls
39. Oil Filler Plug ("One Shot" System)
40. Oil Level Sight Glass
41. Table Swivel Locking Screw (4)
42. Feed Change Handle and Dial
43. Vertical Feed Spindle (Hand Adjustment)
44. Oil Level Sight Glass (Feed Gearbox)
45. Coolant Pump Switch
46. Longitudinal Feed Engagement Lever
47. Table Locking Screws (2)
48. Longitudinal Traverse Trip Stops
49. Longitudinal Feed Handwheel
50. Cross Feed Spindle (Hand Adjustment)
51. Ammeter
52. Push Button Control Panel

Installation of the Machine

LIFTING THE MACHINE

An eyebolt is provided fro screwing into the upper surface of the overarm and with this eyebolt in position the machine can be lifted by passing a wire sling through the eyebolt and looping the sling onto the crane hook, see Fig. 1.

Check to ensure that the lifting sling is of correct capacity to lift the weight of the machine and that the sling is in good condition.

FOUNDATION

The foundation for the machine should be prepared to the dimensions given on Page 7 dependent upon the size of the machine to be installed. Ample sized holes should be provided in the foundation for the four rag-bolts. The minimum depth of concrete required for the foundation is 10" but is dependent upon the customer's knowledge of local conditions of the ground on which the machine is going to stand. Some machine shop floors are designed to carry heavy machine weights but the best results are obtained from the preparation of a separate foundation.

INSTALLATION

(A) Lift the machine and, through each of the four holes provided in the base of the machine, fit a rag-bolt with a nut and a washer, the nut being screwed onto the bolt so that the end of the bolt is just flush with the upper surface of the nut.

(B) Lower the machine onto the foundation guiding the rag-bolts into their appropriate holes in the foundation.

(C) Clean the working surface of the machine table thoroughly.

(D) With a precision level on the machine table, level the machine longitudinally and transversely by means of the use of varying thicknesses of metal packing pieces placed between the surface of the foundation and the underside of the machine base. Adjustments to the height of these packing pieces should be made until the level reads zero both longitudinally and transversely.

(E) Grout should then be run into the rag-bolt holes and under the machine until the grout level is approximately ¾" above the under surface of the machine base. This procedure usually necessitates a rectangular wooden frame being placed around the base of the machine so that the grout is retained. The inside dimensions of the rectangular frame should be approximately 12" larger than the overall dimensions of the machine base in each direction and of sufficient height to retain the grout to a depth of ¾" above the under surface of the machine base.

(F) A full 24 hours should be allowed for the grout to cure and, after this time has elapsed, the rag-bolt nuts should be tightened but very little movement should be experienced at the nuts if the grout has cured sufficiently and the metal packings were placed under the machine securely.

(G) Check the level of the machine longitudinally and transversely.

CLEANING

Machines are despatched from our works with a coating of rust preventative applied to the slideways ad all bright parts. This preventative must be completely removed before the machine is put into service and the slideways should then be coated with a film of oil.

Note:— Before connecting the machine to the electrical supply check oil levels as instructed in section dealing with **LUBRICATION** — See Pages 24 - 28.

ELECTRICS

Cable entry for the electrical supply to the machine is provided on the underside face of the main electrical panel 55. fig. 3 towards the rear of the machine. Access to the control panel is obtained by the key provided but the panel door can not be opened unless the Rotary Isolator Switch 54. fig. 3 is turned to the "Off" (O) position.
Connect the three phase electrical supply to the terminals marked R,S and T and the Earth to the terminal marked ⏚ which are situated at the left hand end of the connection block which runs parallel to and just above the bottom horizontal face of the control panel. Switch on the electrical supply to the machine by rotating the Rotary Isolator Switch 54. fig. 3 to the "On" (1) position and the Red Mains Indicator light 53. fig. 3 will light up showing that power is available for the machine to run.
The main motor should now be checked for the correct direction of rotation as follows:-

The operators electrical control panel is built into the front of the Knee 52 — Fig. 4. Three push buttons are grouped together, marked "SPINDLE" at the lower right hand of this panel. The upper one is marked "STOP" and the two lower ones are provided with circular arrows, the left hand one indicating **anti-clockwise rotation** and the right hand one indicating **clockwise rotation.** Dependent upon which of these two buttons is depressed determines the direction in which the main spindle should rotate when viewed from the front of the machine. Next to the left hand spindle direction push button is a red push button with a white arrow engraved on it and above this button are the words "NORMAL" and "INCH". The arrow must be turned to the "NORMAL" position.

The push button indicating **clockwise rotation** of the spindle can now be depressed **and providing the spindle rotates clockwise** the phases of the electrical supply have been connected correctly. If the spindle rotates anti-clockwise any two of the three phases connected at 'R', 'S' & 'T' in the main electrical panel should be reversed.

INSTALLATION OF THE MACHINE (Continued)

It is **important** that the main motor runs in the correct direction as all the internal wiring for the Feed Motor and Coolant Pump Motor has been 'phased' accordingly so that 'feeds' of the various elements move in the direction indicated by appropriate arrows on the control levers.

In control panel 52 – Fig. 4 a Pilot Light is provided above the "Spindle Stop Button" which when lit indicates the main motor is running.

Once the direction of rotation of the main spindle corresponds to the indicator arrows of the "spindle push buttons" the spindle can be run for a short period to ensure oil is being circulated in the speed gear box. This should be checked by observing the oil flow indicator 1A – Fig. 2 R.H. Side of machine for No. 2 Machine or 1 – Fig. 2 L.H. Side of machine for No. 3 or No. 4 Machines.

Next check the Feed Motor for operation. Two push buttons are provided in Panel 52 – Fig. 4 marked "FEED", "START" and "STOP" and a Pilot Light is also provided to indicate that the Feed Motor is running when lit.

The feed motor can be started, but before engaging any of the power feeds ensure that the following slide locks are "off".

(1) Vertical Slide Locks – 4 – Fig. 2.
(2) Cross Slide Locks (Normal & Heavy Duty) – 13 – Fig. 2.
(3) Longitudinal Slide Locks – 47 – Fig. 4.

Panel 52 – Fig. 4 is also provided with an Ammeter 51 – Fig. 4 and Coolant Pump Switch 45 – Fig. 4.

Operating Instructions

CONTROL OF SLIDEWAY MOVEMENTS

With the Feed Motor running:—

VERTICAL FEED

To Elevate Knee under Power Feed

Move Lever 15 — Fig. 2 at left hand side of Knee downwards to "FEED" position. Move Lever 26 — Fig. 3 at right hand side of Knee upwards and Knee will move upwards. When the required position has been reached return lever 26 — Fig. 3 to Neutral position.

To Lower Knee under Power Feed

With Lever 15 — Fig. 2 still in "FEED" position, move Lever 26 — Fig. 3 downwards and the Knee will lower. When the required position has been reached return Lever 26 — Fig. 3 to Neutral position.

To Raise or Lower Knee under Rapid Traverse

With Lever 15 — Fig. 2 in lower position "FEED", select direction of movement required (UP or DOWN) with Lever 26 — Fig. 3 as described above putting Knee into Power Feed then move Lever 15 — Fig. 2 up through Neutral point to the upper position "RAPID TRAVERSE" when the Knee will rapid traverse in the direction selected. When the required position has been reached return Lever 15 — Fig. 2 to Neutral position.

Vertical Feed Trip Stops

Two moveable Trips are provided at the right hand side of the column adjacent to the column slide 35 — Fig. 3.

These two moveable Trips can be pre-set so that the normal feed or rapid traverse is tripped out at the required upper or lower position of the Knee when the Lever which protrudes from the back of the Knee comes into contact with either of the adjustable Trips. Fixed Stops are fitted at the extreme upper and lower ends of the slide which carries the adjustable Trips. These fixed stops determine the extreme positions at which the adjustable Trips can be set.

Note:—It is most important that the Adjustable Trips and the Fixed Stops are not removed from their carrying slide as these components safeguard the internal mechanism of the feed system. If removed the Knee will over run its maximum permitted position and severe damage will be caused to the feed mechanism.

CROSS FEED VERTICAL FEED

To Power Traverse Table Saddle towards Column Face

Move Lever 15 – Fig. 2 at left hand side of Knee downwards to "FEED" position. Move Lever 23 – Fig. 3 at right hand side of Knee to upper position and Table Saddle will move towards the column face. When the required position has been reached return Lever 23 – Fig. 3 to Neutral position.

To Power Traverse Table Saddle away from Column Face

With Lever 15 – Fig. 2 still in "FEED" position, move Lever 23 – Fig. 3 to lower position and Table Saddle will move away from the column face. When the required position has been reached return Lever 23 – Fig. 3 to Neutral position.

To Rapid Traverse Table Saddle in Either Direction

With Lever 15 – Fig. 2 in lower position "FEED" select direction of movement (IN or OUT) with Lever 23 – Fig. 3 as described above putting Table Saddle into Power Feed then move Lever 15 – Fig. 2 up through the Neutral point to the upper position "RAPID TRAVERSE" when the Table Saddle will Rapid Traverse in the direction selected. When the required position has been reached return Lever 15 – Fig. 2 to Neutral position.

Cross Feed Trip Stops

Two moveable Trips and two Fixed Stops are provided at the right hand side of the Knee mounted on a Trip Bar 27 – Fig. 3.

The two moveable Trips can be pre-set so that the normal feed or rapid traverse is tripped out at the required "Inner" or "Outer" position of the Table Saddle when the projection on the under side of the Table Saddle comes into contact with either of the adjustable Trips. The Fixed Stops determine the extreme positions at which the "Inner" and "Outer" adjustable Trips can be set.

Note:—It is most important that the Fixed Stops are **not freed or removed** from the Trip Bar as these components safeguard the internal mechanism of the feed system. If freed or removed the saddle will over run its maximum permitted position and severe damage will be caused to the feed mechanism.

LONGITUDINAL TABLE FEED

To Power Traverse Table to the Right

Move Lever 15 – Fig. 2 at Left hand side of Knee downwards to "FEED" position. Move Lever 46 – Fig. 4 to the right and the table will feed from left to right. When the table has reached the required position, return Lever 46 – Fig. 4 to Neutral position.

To Power Traverse Table to the Left

With Lever 15 – Fig. 2 still in "FEED" position move Lever 46 – Fig. 4 to the left and the table will feed from right to left. When the table has reached the required position, return Lever 46 – Fig. 4 to Neutral position.

To Rapid Traverse Table in Either Direction

With Lever 15 – Fig. 2 in lower position "FEED" select direction of movement (RIGHT or LEFT) with Lever 46 – Fig. 4 as described above putting Table into Power Feed then move Lever 15 – Fig. 2 up through the Neutral point to the upper position "RAPID TRAVERSE" when the Table will Rapid Traverse in the direction selected. When the required position has been reached, return Lever 15 – Fig. 2 to Neutral position.

Longitudinal Feed Trip Stops

Two moveable and two Fixed Trips are provided on the front edge of the Table 48 – Fig. 4. The two moveable Trips can be pre-set so that the normal feed or rapid traverse is tripped out when the respective Trip comes into contact with its Trip Plunger situated adjacent to Lever 46 – Fig. 4. The Fixed Trips determine the extreme positions of the Table movement to either right or left.

Note:—It is most important that the Fixed Stops are not removed from the edge of the Table as these components safeguard the internal mechanism of the feed system. If removed the table will over run its maximum permitted position and severe damage will be caused to the feed mechanism.

SWIVELLING OF WORK TABLE

The machine table can be swivelled in relationship to the saddle.

The table is provided with a scale graduated in degrees which is read in conjunction with a fixed zero mark on the front face of the saddle.

The table can be swivelled 45° either side of the longitudinal centre line of the table.

The table is locked to the saddle by four Table Swivel Locking Screws, one of which is shown at 41 – Fig. 4, there is also one in the rear face of the saddle directly in line with the previously mentioned one at 33 – Fig. 3 and two in the right hand end face of the saddle.

To set the table over at the required angle, slacken the four Table Swivel Locking Screws, swivel the Table to the required angle and securely lock the table in position by tightening the four Table Swivel Locking Screws.

COOLANT SYSTEM

The machine incorporates a coolant system, the sump for which is built into the base of the machine and can be filled by removing the cover to which the coolant return tube from the machine table is connected at the right hand side of the base. The electrically driven coolant pump is controlled by a rotary switch provided in the control panel at the front of the knee.

To gain access to the coolant pump, remove cover 9 — Fig. 2.

Use a good quality coolant so that unnecessary sludge and corrosion conditions are eliminated. We recommend the use of Shell Dromas Oil B.

OVERARM, ARBOR AND ARBOR SUPPORTS

The top of the main column is provided with a well proportioned dove-tail slideway which accepts the mating dove-tail formed on the underside of the Overarm which is positioned by a closely fitting locking strip. The Overarm is locked in the required position by means of two Overarm Locking Nuts 30 — Fig. 3.

In the case of the No. 2 Size Machine the Overarm is pushed to the position required with the Overarm Locking Nuts 30 — Fig. 3 loose.

In the case of the No. 3 & No. 4 Size Machines a Handwheel 29 — Fig. 3 is provided. By rotating this Handwheel in the appropriate direction the Overarm can be positioned as required when the Overarm Locking Nuts 30 — Fig. 3 are loose. This movement is effected by a pinion which is mounted on the Handwheel shaft engaging with a rack which is cut in the underside of the Overarm.

The two Arbor Support Brackets locate on the dove-tail formed on the underside of the Overarm, ensuring perfect alignment of the centres of the bearings in the Arbor Support Brackets with the centre-line of the Main Spindle. The Arbor Support Brackets can be set at any required position on the dove-tail location of the Overarm and can be secured to the Overarm by Locknut 28 — Fig. 3.

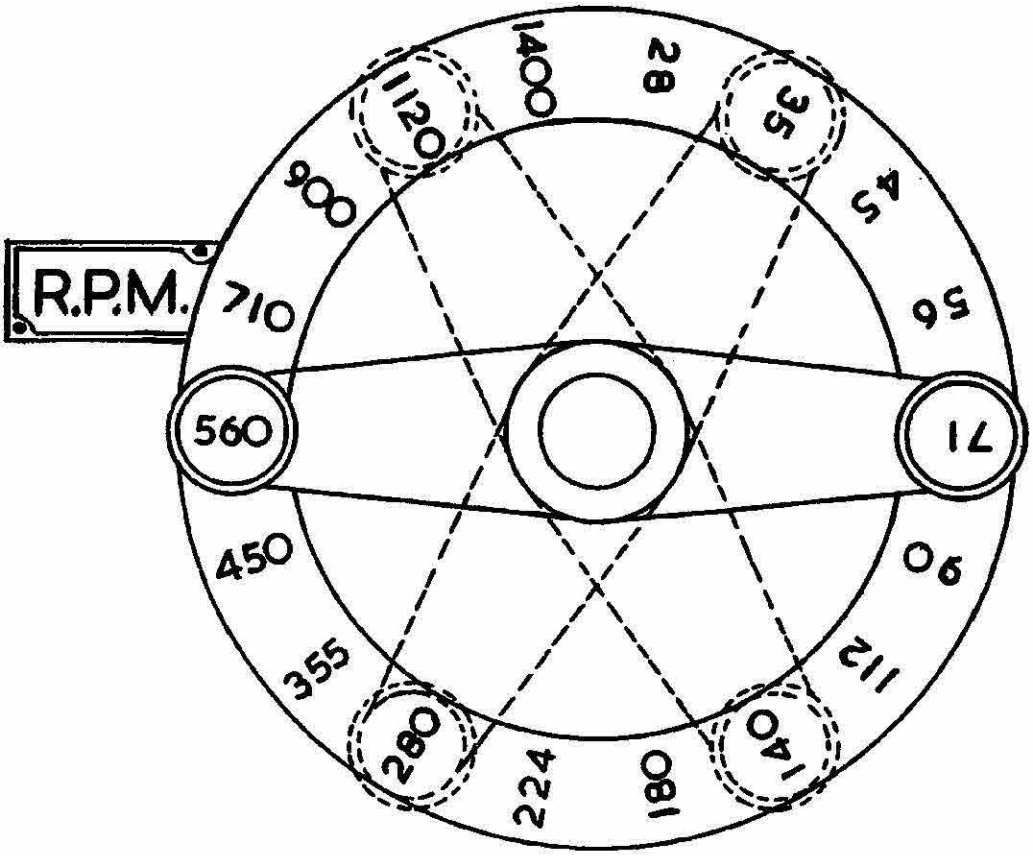
The Bores of the Overarm Support Brackets are provided with Needle Bearings and are fitted with dust tight Oil Lubrication Nipples which require hand Lubrication with Shell Tellus 29 Oil. The Overarm Support Bracket Bearings should be lubricated frequently.

As guidance, when setting the milling cutter on the Arbor, arrange that the cutter is as close to the main spindle nose as is practically possible with the Arbor Support Brackets set as close as possible to the cutter, on either side of the cutter and that the Running Bushes on the Arbor are so spaced that the needles of the Arbor Support Bearings are in complete contact with the bearing surface of the Running Bushes. Arranging conditions as described above will allow the machine to be used to full advantage.

The No. 2 Size Machine has the main spindle bore prepared to accept Arbors with ISO 40 Taper.

The No. 3 & No. 4 Size Machines have the main spindle bore prepared to accept Arbors with ISO 50 Taper.

Arbors are provided with a selection of differing lengths of spacing bushes and two Running Bushes. Great care must be taken of these Running Bushes, ensuring that they are not knocked or dropped as the outer surface of them forms the inner race of the needle bearings fitted to the Arbor Support Brackets.

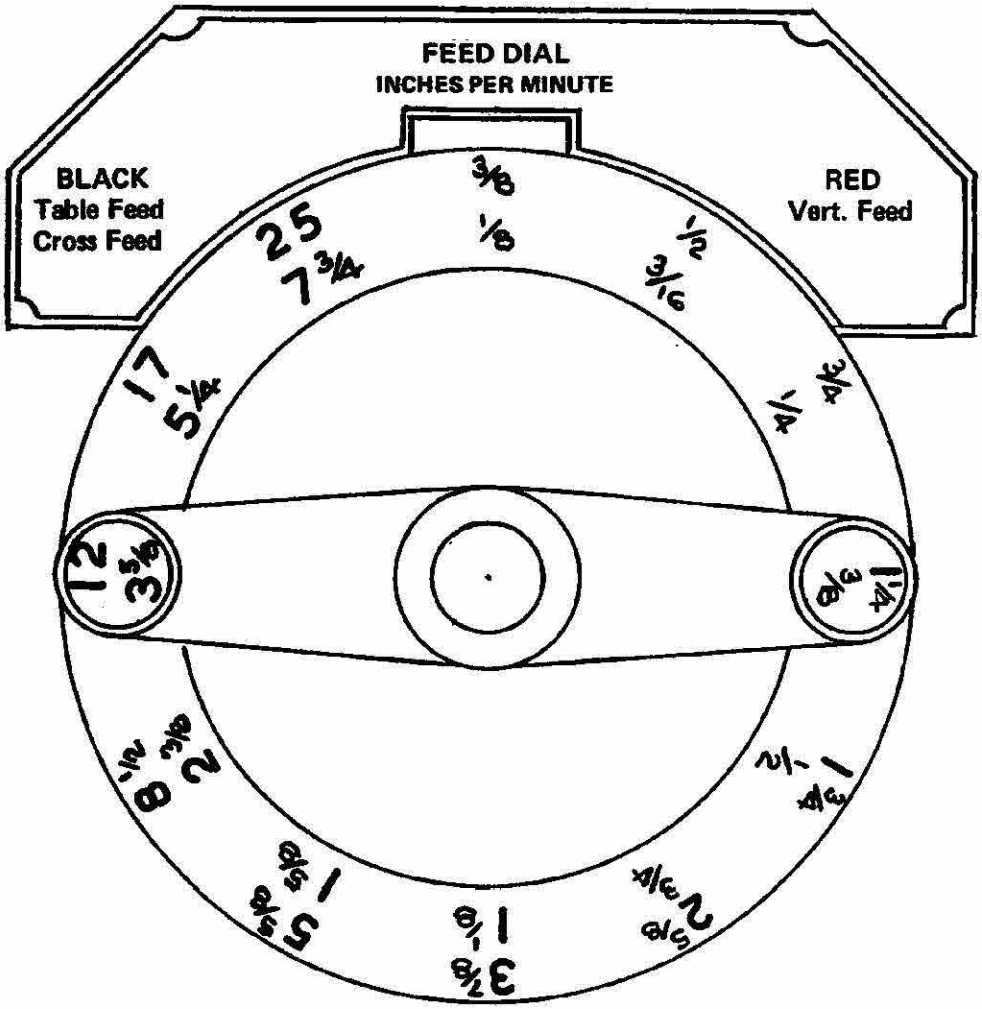


TO CHANGE SPINDLE SPEED

Note:—SPINDLE SPEED CHANGES MUST NOT BE ATTEMPTED WITH THE MAIN MOTOR RUNNING.

The "RED" Push Button with the White arrow engraved on it situated in Control Panel 52 — Fig. 4 should be depressed and turned clockwise so that the arrow indicates to the word "INCH" on the Control Panel Plate. This setting isolates all the other push-buttons in the panel and safe-guards the machine from damage should any of the other push-buttons be inadvertantly depressed during the spindle speed change operation.

The Spindle Speed Change Handle and Dial are situated at the right hand of the machine column 31 — Fig. 3 and close to the Spindle Speed Change Handle is the "INCH" Push Button 32 — Fig. 3. There is a fixed indicator provided on the column bearing the letters R.P.M. close to the edge of the Dial as shown in diagram above. Engraved around this Dial are 18 numbers ranging from 28 to 1400. These numbers are the spindle speeds which can be selected. The number on the Dial which aligns with the R.P.M. indicator is the speed at which the main spindle will rotate. By rotating Handle 31 — Fig. 3 in either direction the Dial will rotate and the Handle should be rotated until the required spindle speed on the Dial aligns with the R.P.M. indicator. Should difficulty be experienced in turning Handle 31 — Fig. 3, the "INCH" Push Button should be depressed momentarily thus turning the shafts in the gearbox and allowing the mating gear teeth of the various gears to engage with each other. When the required spindle speed has been engaged the "RED" Push Button with the white arrow engraved on it should be rotated anti-clockwise so that the arrow indicates to the word "NORMAL" on the Control Panel Plate.



TO CHANGE FEED RATE

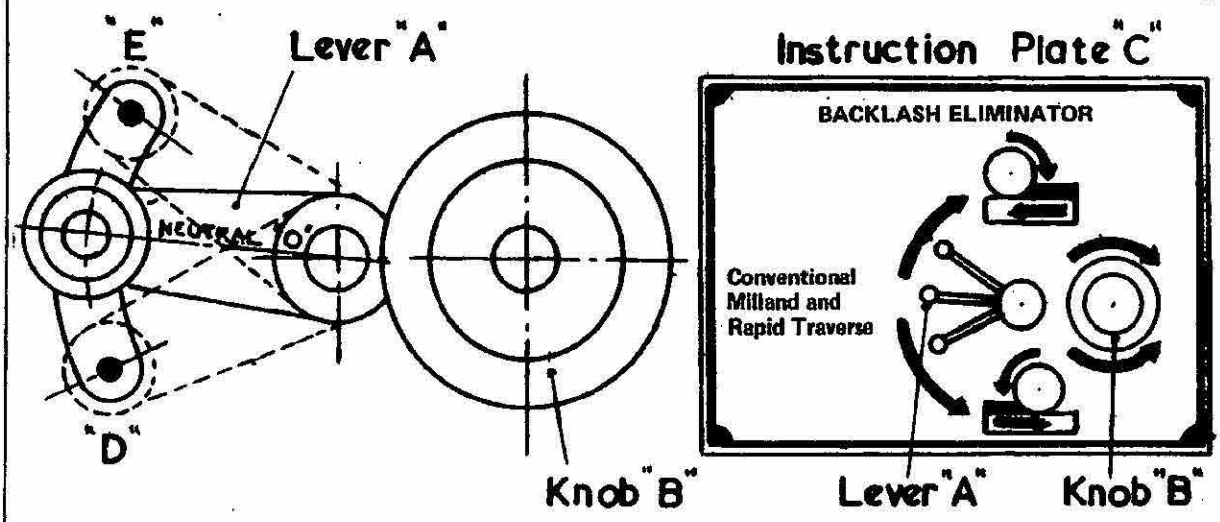
Note:—IT IS MORE CONVENIENT TO CHANGE FEED RATE WHEN THE FEED MOTOR IS RUNNING.

The "START" and "STOP" Push Buttons which control the Feed Motor are situated in the Control Panel 52 — Fig. 4 along with a Pilot Light which indicates when the Feed Motor is running.

The Feed Rate Change Handle and Dial 42 — Fig. 4 are situated at the left hand front face of the Kne The Dial is engraved with two rows of figures. The outer row of "BLACK" figures indicate the feed rate in "INCHES PER MINUTE" at which the Table and Cross Slide will feed at, and the inner row o "RED" figures indicate the vertical feed rate at which the Knee will feed at for a particular setting of the Dial.

There is a fixed indicator provided adjacent to the top of the Dial as shown in diagram above. The figure on the Dial which aligns with the rectangular cut out in the indicator plate below the words "INCHES PER MINUTE" is the feed rate at which the appropriate slide will feed at.

To select a particular feed rate rotate Handle 42 — Fig. 4 in either direction until the required feed ra on the Dial aligns with the rectangular cut out in the indicator plate.



BACKLASH ELIMINATOR

The longitudinal table screw is provided with a Backlash Eliminator which is situated at the left hand front of the Table Saddle 38 – Fig. 4.

Note:—THIS UNIT IS ONLY TO BE ENGAGED WHEN THE MACHINE IS TO BE USED FOR CLIMB MILLING.
WHEN CONVENTIONAL MILLING IS IN PROGRESS LEVER "A" IN DIAGRAM ABOVE MUST BE IN NEUTRAL POSITION (O) AND KNOB "B" MUST BE IN "FREE" STATE.

This feature is provded with two controls Lever "A" and Knob "B" as shown in above diagram and an Indicator Plate "C".

SETTING OF THE BACKLASH ELIMINATOR

With the Feed Motor Running:—

To climb mill with the table movement from left to right engage table feed by moving Lever 46 – Fig. 4 to the right. Engage Lever "A" (shown in diagram above) in position ("D"). Rotate Knob "B" anti-clockwise until resistance to rotation is felt.

Note:—Cutter must rotate anti-clockwise when viewed from the front of the machine for table movement left to right.

To climb mill with the table movement from right to left engage table feed by moving Lever 46 – Fig 4 to the left. Engage Lever "A" (shown in diagram above) in position ("E"). Rotate Knob "B" clockwise until resistance to rotation is felt.

Note:—Cutter must rotate clockwise when viewed from the front of the machine for table movement from right to left.

The above setting instructions are shown diagramatically on Instruction Plate "C" shown in above diagram and also on the Instruction Plate provided on the machine adjacent to the Bakclash Eliminator Controls.

Rapid Traverse to the Table can be engaged to return the Table to the starting position after a cut has been completed providing Lever "A" is returned to its Neutral (O) position but no adjustment is necessary to Knob "B", When the table has returned to the start position for the commencement of another cut Lever "A" must be returned to the appropriate engaged position.

Note:—It is most important that when Conventional Milling is in progress that Lever "A" is in the Neutral (O) position and Knob "B" is in the "free" state.

N°2 and N°3 Universal Mills

Lubrication of Machine

Note ~ for Shell Tellus 29 read Shell Tellus 46

MAIN SPINDLE GEARBOX (Column)

The Spindle Gearbox is fitted with a lubrication pump which lifts oil from the oil reservoir at the bottom of the gearbox to an oil gallery at the top of the column as shown in Fig. 5a or Fig. 5b dependent on the size of machine. Oil is then fed from the gallery through piping or ports (not all shown) to the Main Spindle Bearings, intermediate bearings and gears.

USE SHELL TELLUS 29 OIL OR EQUIVALENT

To fill the Spindle Gearbox:–

1) Remove Filler Plug 2 or 2A – Fig. 2 dependent on size of Machine.

2) Fill gearbox until oil level shows just above halfway up Oil Level Sight Glass 7 – Fig. 2 when Main Motor is stationary.

3) Replace Filler Plug.

4) With the Main Motor Running check that Oil is being circulated at Sight Glass 1 – Fig. 2 at left hand side of column on No. 3 & No. 4 size machines and at 1A – Fig. 2 at right hand side of column on No. 2 size machine.

Note:–It is most important that oil flow is observed at the above mentioned point and should be checked on each occasion the machine is started up and regularly when in use.

5) The oil level in this gearbox should be checked DAILY at Oil Level Sight 7 – Fig. 2 and should be "topped" up as and when necessary.

6) This gearbox can be drained by removing Plug 8 – Fig. 2.

FEED GEARBOX (Knee)

The Feed Gearbox is provided with an Oil Sump and all the associated gears, shafts and bearings are lubricated by the "splash" system.

USE SHELL TELLUS 29 OIL OR EQUIVALENT

To fill the Feed Gearbox:–

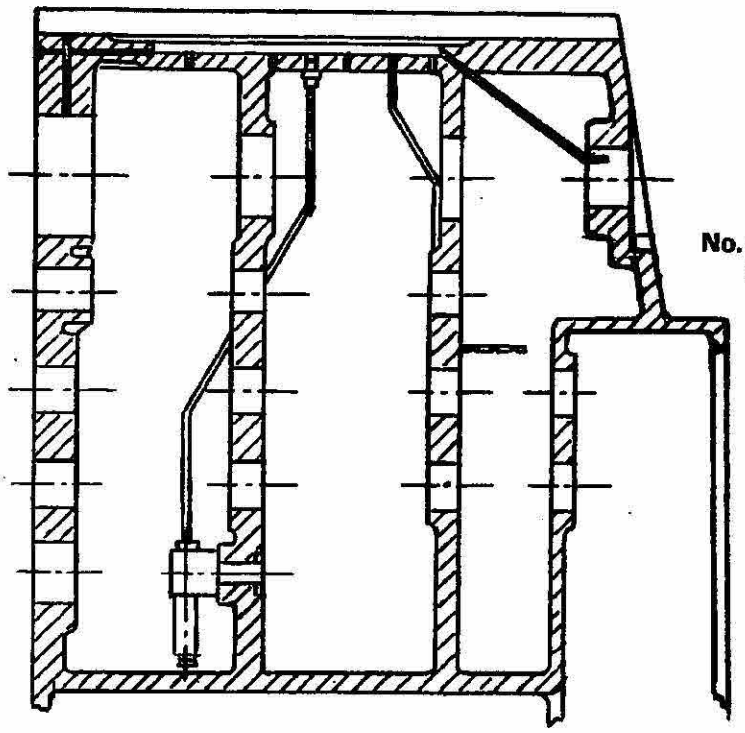
1) Remove Filler Plug 34 – Fig. 3

2) Fill gearbox until oil level shows just above halfway up Oil Level Sight Glass 44 – Fig. 4 when Feed Motor is stationary.

3) Replace Filler Plug.

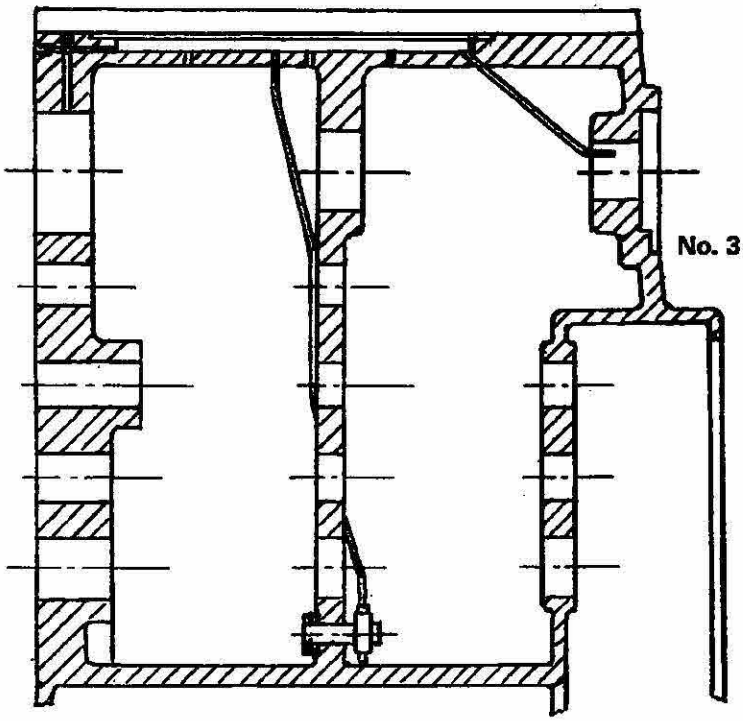
4) The oil level in this gearbox should be checked DAILY at Oil Level Sight 44 – Fig. 4 when Feed Motor is stationary and should be "topped" up as and when necessary.

5) This gearbox can be drained by removing Plug 18 – Fig. 2.



No. 2 MACHINE
Fig. 5 (a)

AUTOMATIC LUBRICATION SYSTEM OF SPINDLE SPEED GEARBOXES



No. 3 & No. 4 MACHINES
Fig. 5 (b)

LUBRICATION OF MACHINE (Continued)

BEVEL GEAR BOX (Drive to Cross Screw and Table)

This gearbox is provided with an Oil Sump and the associated gears and bearings are lubricated by the "Splash" system.

USE SHELL TELLUS 29 OIL OR EQUIVALENT.

To Fill Bevel Gear Box:–

1) Remove Filler Plug 22 – Fig. 3

2) Fill gearbox until oil level shows just above halfway up Oil Level Sight Glass 24 – Fig. 3.

3) Replace Filler Plug.

4) The oil level in this gearbox should be checked DAILY at Oil Level Sight 24 – Fig. 3 and should be "topped" up as and when necessary.

5) This gearbox can be drained by removing Plug 24A – Fig. 3.

CROSS SCREW NUT AND TABLE DRIVE HOUSING

This housing is provided with an Oil Sump and the associated gears and bearings are lubricated by the "splash" system. Also fitted to this housing is a "One Shot" system for the lubrication of the Cross Screw & Nut.

To fill the Housing:–

USE SHELL TELLUS 29 OIL OR EQUIVALENT

1) Remove Filler Plug 21 – Fig. 3.

2) Fill Housing until oil level shows just above halfway up Oil Level Sight Glass 20 – Fig. 3.

3) Replace Filler Plug.

4) The oil level in this Housing should be checked DAILY at Oil Level Sight 20 – Fig. 3 and should be "topped" up as and when necessary.

Important:– The Push Button 25 – Fig. 3 of the "One Shot" Lubrication Pump should be depressed twice every two hours the machine is in use to ensure the Cross Screw and Nut are kept well lubricated.

5) This Housing can be drained by removing Plug 25A – Fig. 3.

ELEVATING NUT AND SCREW

The Housing which supports the elevating nut and screw is provided with an oil reservoir and lubrication of the nut and screw is effected by displacement of the oil in this reservoir as the screw moves up and down.

LUBRICATION OF MACHINE (Continued)

USE SHELL TELLUS 29 OIL OR EQUIVALENT

To fill the Elevating Nut & Screw Housing:–

1) Elevate Knee to its maximum raised position.

2) Remove Filler Plug 36 – Fig. 3.

3) Fill Housing until oil level shows just above halfway up Oil Level Sight Glass 37 – Fig. 3.

4) Replace Filler Plug.

Important:– Lower Knee to its lowest position when screw will be immersed in oil and oil will be displaced upwards thus lubricating the screw over its full length.

The Knee of the machine must be moved up its maximum height and lowered to its minimum height at least once each day and the oil level in the reservoir should be checked DAILY at Oil Level Sight Glass 37 – Fig. 3. and should be "topped" up as and when necessary when the Knee is raised to its full extent.

"ONE SHOT" LUBRICATION SYSTEM TO CROSS AND LONGITUDINAL SLIDEWAYS ETC.

The machine is fitted with a "One Shot" Lubrication System which supplies oil to the Cross Slide, Table Slide, Table Nut Screw and associated Gearing and Bearings.

USE SHELL TELLUS 29 OIL OR EQUIVALENT

To fill the "One Shot" Lubrication System:–

1) Remove Filler Plug 39 – Fig. 4.

2) Fill reservoir until oil level shows just above halfway up Oil Level Sight Glass 40 – Fig. 4.

3) Replace Filler Plug.

4) The oil level in this reservoir should be checked DAILY at Oil Level Sight Glass 40 – Fig. 4 and should be 'topped' up as and when necessary.

5) The "One Shot" Plunger 12 – Fig. 2 should be operated once every half hour when the machine is in regular use. The Plunger is withdrawn and allowed to return to its inner position under spring pressure.

If the machine has stood over a week-end or for a prolonged period of time the "One Shot" Plunger 12 – Fig. 2 should be operated at least six times initially and then at half hourly periods.

THE FOLLOWING POINTS REQUIRE MANUAL LUBRICATION

1) An Oil Nipple is provided at either side of the Knee Casting at the top and on the edge of the part forming the vertical slide which fits on to the column face. These nipples supply oil to the dove-tail and flat faces of the slideway. These points require lubrication very frequently (every four hours) with Shell Tellus 29 Oil or Equivalent.

2) A Grease Nipple is provided at the right hand end of the saddle between the two Swivel Locking Screws 33 – Fig. 3. This nipple supplies grease to the Table Drive Gears and should be lubricated

once every four weeks with Shell Alvania Grease or Equivalent.

3) Each Arbor Support Bracket is provided with an Oil Nipple. This nipple supplies oil to the Needle Bearing and should be lubricated with Shell Tellus 29 Oil or Equivalent frequently.

4) If a Vertical or Universal Milling Head is provided Shell Alvania Grease should be used to lubricate the Bearings and Gears through the grease nipples provided at intervals of three months.

MOST IMPORTANT

The oil must be changed in the following:—

a) Main Spindle Gearbox (Column)

b) Feed Gearbox (Knee)

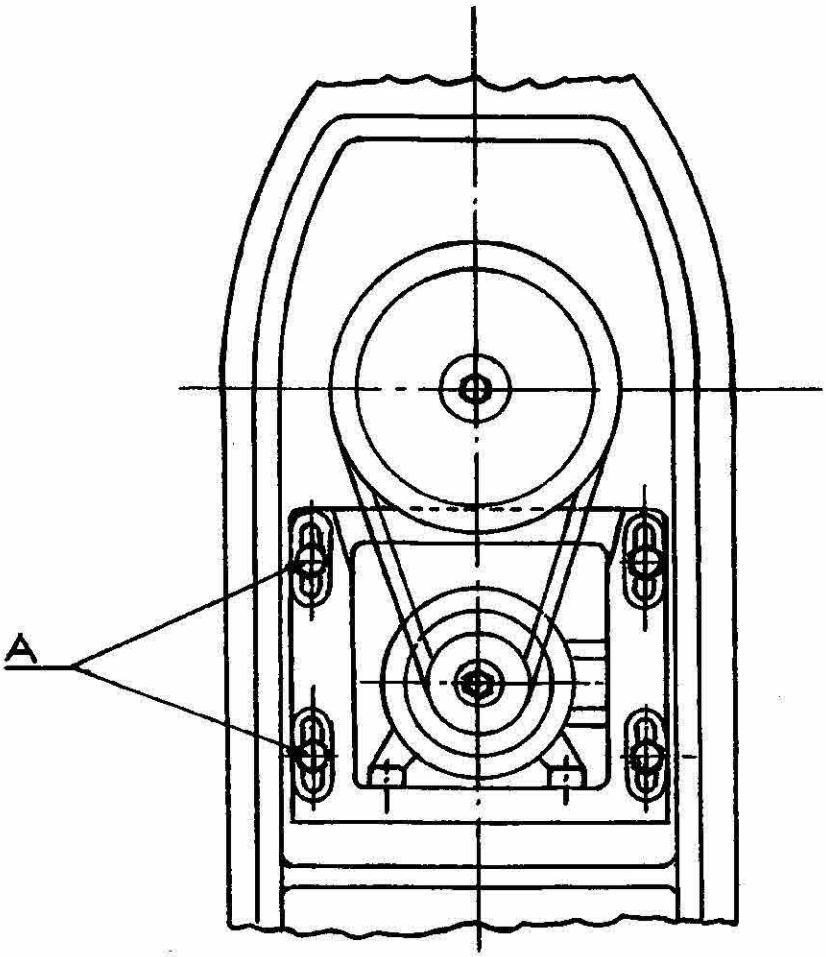
c) Bevel Gearbox (Knee)

d) Cross Screw Nut and Table Drive Housing (Underside of Saddle)

initially after the first 100 hours running time and then at six monthly intervals or 1,000 hours running time, whichever is the shorter period.

When changing the oil in the above units each unit should be drained off and the unit should be flushed out with a good quality flushing fluid prior to re-filling with new Shell Tellus 29 Oil or Equivalent.

Maintenance



ADJUSTMENT OF MAIN "VEE" ROPE DRIVE

The above diagram shows the arrangement of the Main Drive to the Machine.

The primary shaft of the speed gear box is driven by an Electric Motor through 'Vee' Belt Pulleys and 'Vee' Belts.

To adjust the tension of the 'Vee' Belts:–

1) Remove Cover 9 – Fig. 2 at rear of Machine.

2) Slacken slightly the four Hexagonal Head Set Screws "A" shown in diagram above thus releasing the mounting which carries the Main Driving Motor. By releasing the screws the Motor Mounting will slide downwards due to the weight of the Motor and will provide the required tension to the 'Vee' Belts.

3) Secure the four Hexagonal Head Set Screws thus fixing the Motor Mounting in position.

4) Replace Cover 9 – Fig. 2.

ADJUSTMENT OF MAIN SPINDLE BEARINGS

Fig. 6(a) Shows the arrangement of the main spindle and its associated bearings for the No. 2 Size Machine.

Fig. 6(b) Shows the arrangement of the main spindle and its associated bearings for the No. 3 & No. 4 Size Machine.

The main spindle in each size of machine is supported by three INA Needle Bearings and two ball thrust bearings.

The large needle bearing at the nose end of the spindle is of the adjustable type and consequently radial movement which could develop after a long period of use can be eliminated. This is achieved by the design of the bearing outer race, as increased axial pressure on the outer race reduces the internal diameter of the outer race and consequently reduces the radial clearance between the elements of the bearing.

To carry out this adjustment select a position with the Spindle Speed Change Handle 31 – Fig. 3 where the spindle is not in gear and is free to turn easily by hand. Slacken the four cap screws retaining Ring 'A' Fig. 6a or Fig. 6b as the case may be. Rotate Screwed Adjusting Ring 'B' approximately 10° clockwise. Tighten the four cap screws retaining Ring 'A' ensuring that there is no gap between face of Ring 'A' and its mating surface. Try spindle for free rotation by hand. This procedure should be continued until a slightly increased force is required to rotate the spindle by hand. When this stage is reached the cap screws securing Ring 'A' should be slackened and the Screwed Adjusting Ring 'B' should be rotated a small amount anti-clockwise.

The cap screws securing Ring 'A' should be tightened. If the spindle rotates freely by hand the adjustment is completed.

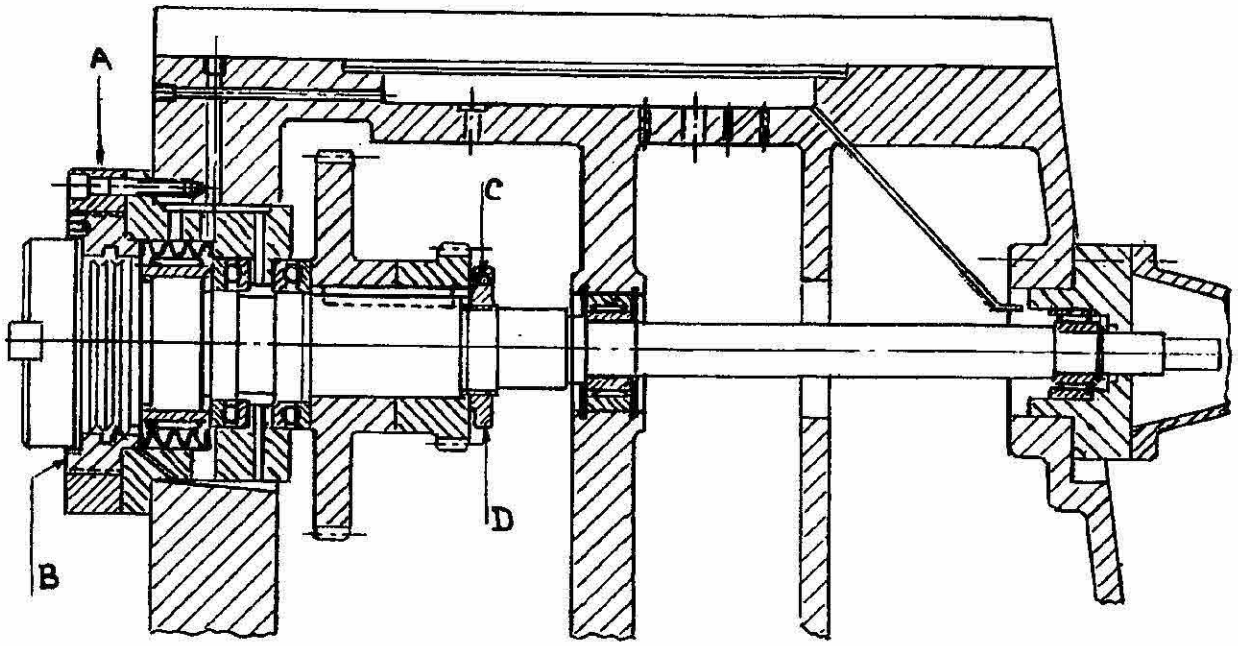
Note:—Over adjustment of Screwed Adjusting Ring 'B' will result in over-heating and rapid failure of the bearing.

Should axial 'float' develop at the spindle nose after a prolonged period of use, this can be eliminated by adjustment of the double row thrust bearings which are mounted on the spindle.

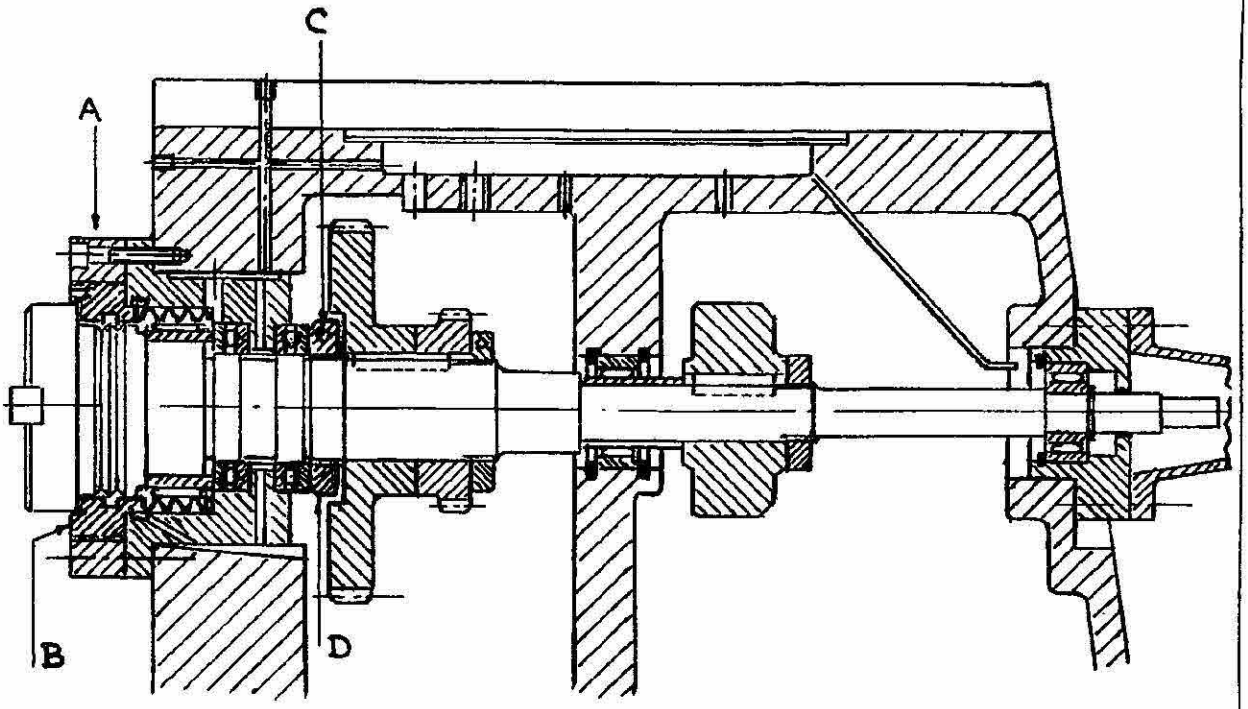
To carry out this adjustment, gain access to the column by removing Cover 3 – Fig. 2. Select a position with the Spindle Speed Change Handle 31 – Fig. 3 where the spindle is not in gear and is free to turn by hand. Slacken Locking Screw 'C' Fig. 6a or Fig. 6b as the case may be, which secures Adjusting Nut 'D'. Turn Adjusting Nut 'D' clockwise, frequently turning the main spindle by hand. Continue this procedure until a slightly increased force is required to rotate the main spindle by hand. When this stage is reached, turn Adjusting Nut 'D' slightly anti-clockwise until the spindle moves freely by hand again. Tighten Locking Screw 'C' securely and replace Cover 3 – Fig. 2.

Note:—Over tightening Adjusting Nut 'D' will result in over-heating and rapid failure of the thrust bearings.

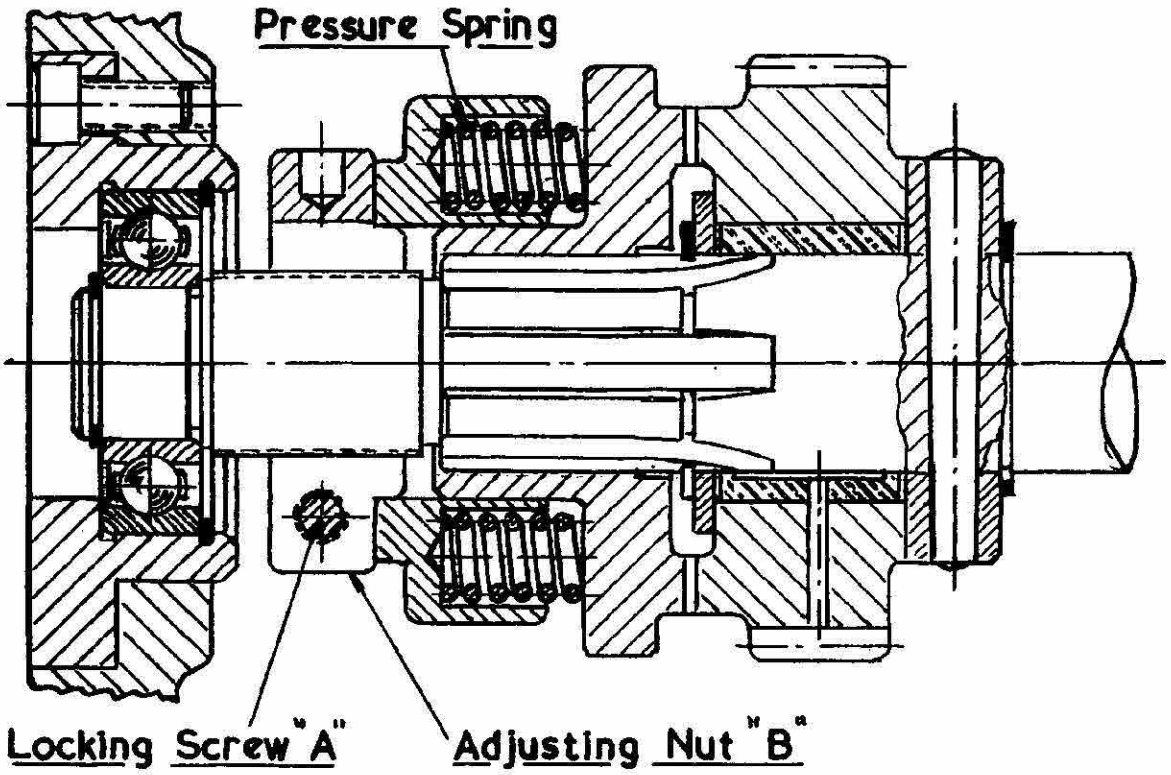
The two needle bearings, one at approximately mid-length of the spindle and the other at the tail end of the spindle are of the non-adjustable type but give great stability to the assembly.



No. 2 MACHINE
Fig. 6(a)



No. 3 & No. 4 MACHINES
Fig. 6(b)



POWER FEED OVERLOAD PROTECTION CLUTCH

This device is fitted in the power feed drive system and is pre-set in the Factory prior to despatch and protects the feed drive from damage due to overloading.

The setting at which this unit is arranged to slip at is that when the three feeds are engaged together, (i.e. – Longitudinal, Cross and Vertical), if the Rapid Traverse is engaged the Clutch will slip (this is noticeable by a rapid clicking sound coming from the knee), but if only two feeds are engaged together, (say Longitudinal and Vertical) and Rapid Traverse is engaged the Clutch will not slip.

Should at any time adjustment of this device be necessary the following procedure should be carried out:–

1) Remove Cover 16 – Fig. 2 to gain access to Overload Clutch.

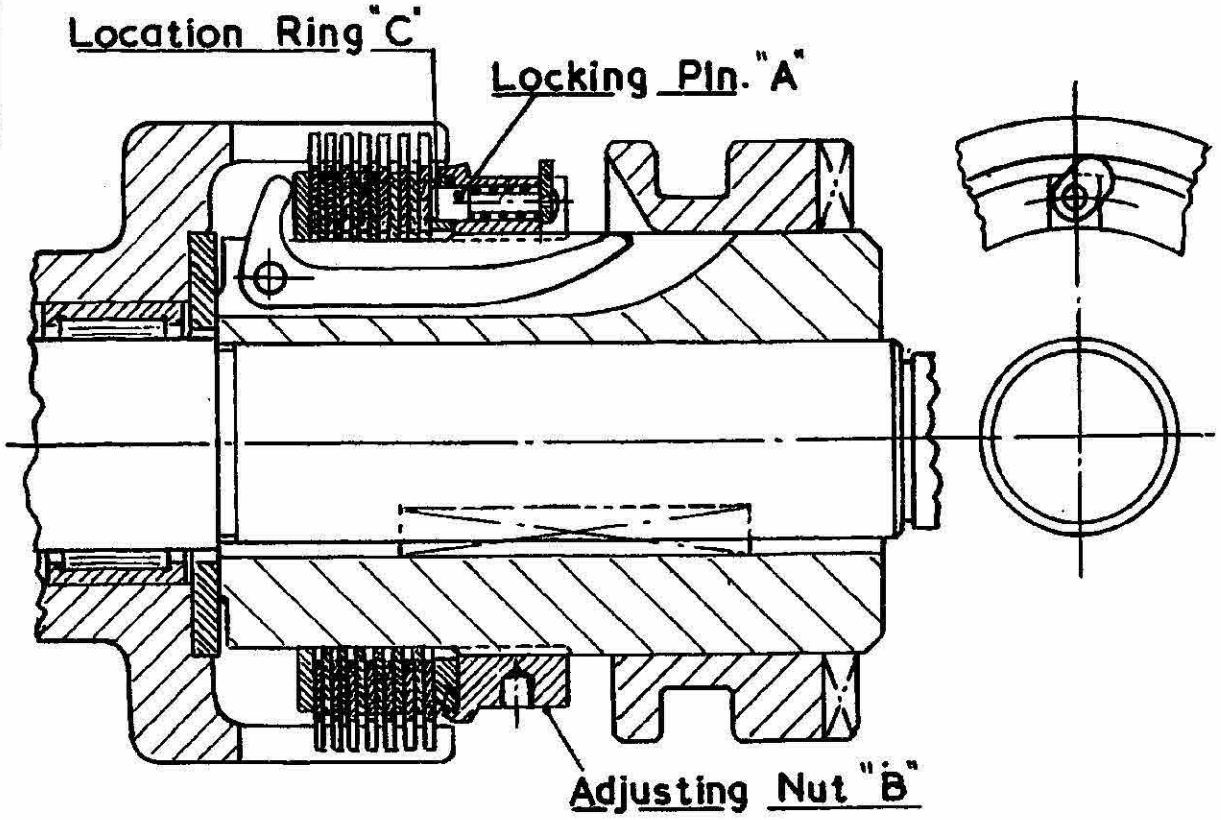
2) Slacken Locking Screw shown at "A" in above drawing

3) Turn Adjusting Nut shown at "B" clockwise in small amounts until above mentioned condition is attained.

4) Tighten Locking screw "A" thus securing Adjusting Nut "B".

5) Replace Cover 16 – Fig. 2.

Note:—It is most important that Adjusting Nut "B" is not over-tightened as the device will be made inoperable and result in damage to the Power Feed System.



RAPID TRAVERSE CLUTCH

The above diagram shows the Clutch which is engaged when Rapid Traverse is selected.

Should slipping of this Clutch be evident after a prolonged period of service adjustment should be carried out as follows:—

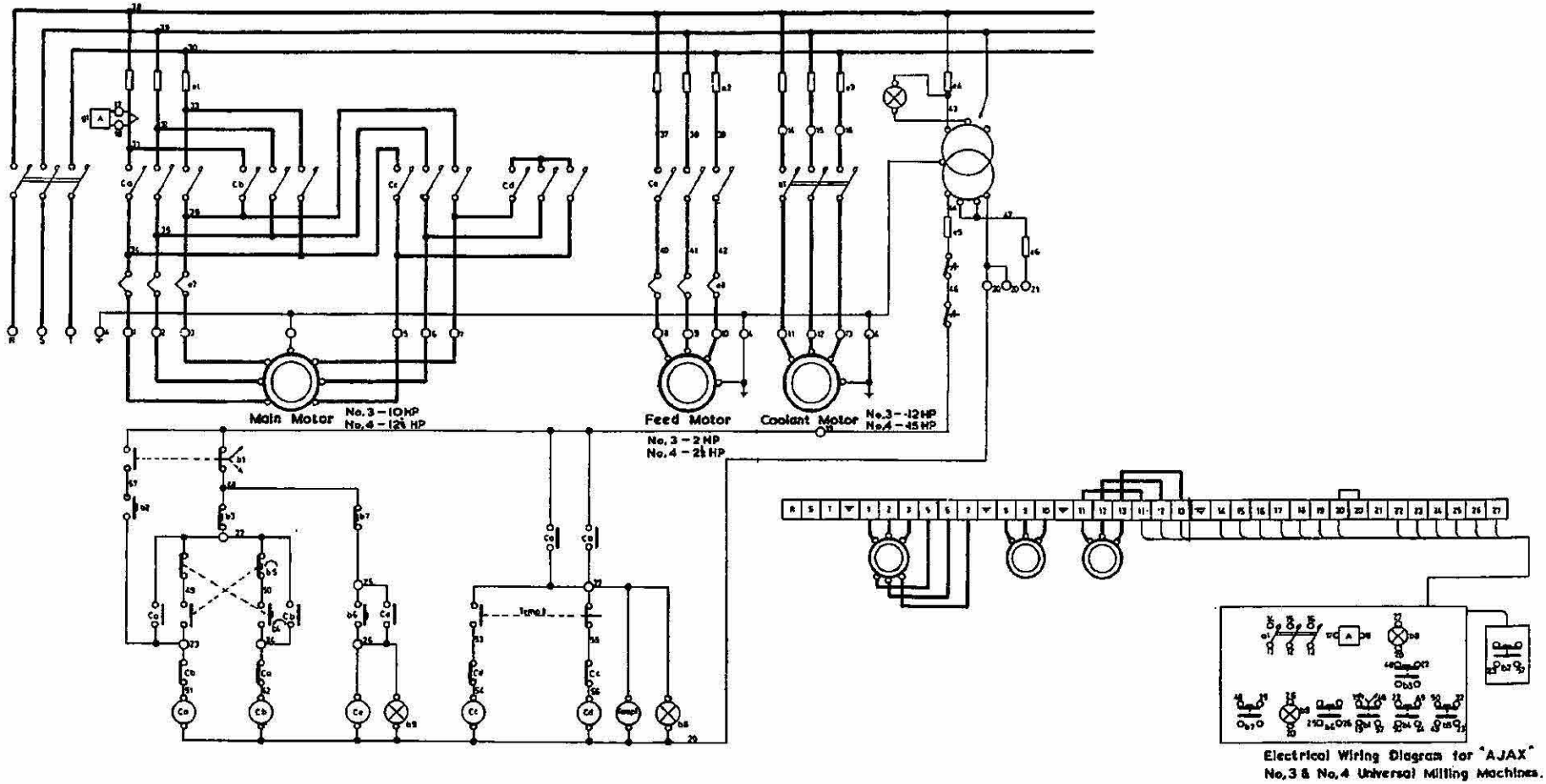
1) Remove Cover 16 — Fig. 2 to gain access to Rapid Traverse Clutch.

2) Disengage Locking Pin "A" by sliding tab on pin to the Right and turn tab as shown in end view so that Locking Pin is retained in the disengaged position.

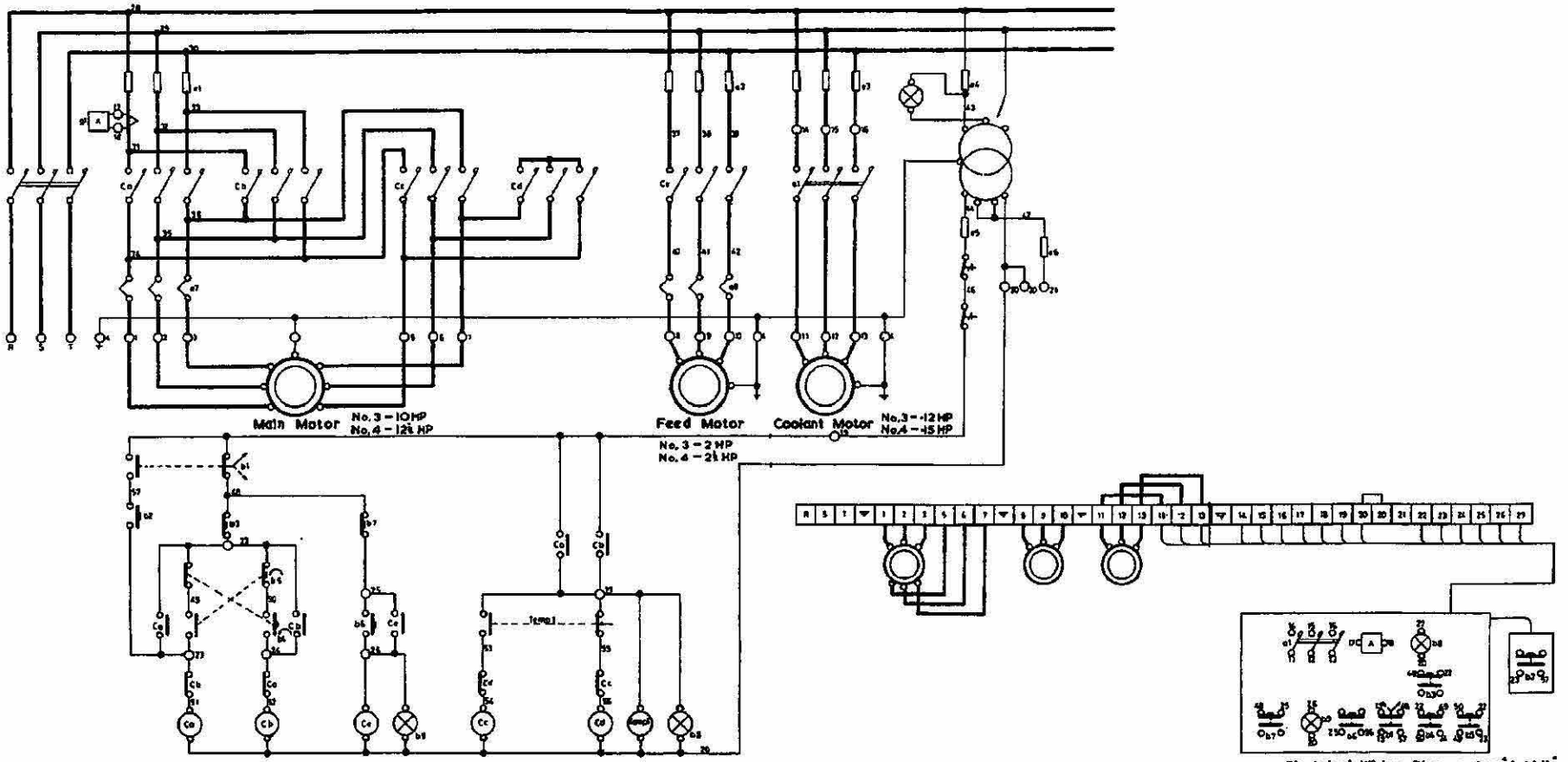
3) Turn Adjusting Nut "B" 1/12th of a turn clockwise. (Location Ring "C" is provided with 12 Location Holes) 1/12th of a turn of Adjusting Nut "B" should be sufficient adjustment when slipping occurs.

4) Turn Tab of Locking Pin so that spring on Locking Pin re-engages Pin into hole in Location Ring "C" rotating Adjusting Nut "B" in either direction until Pin locates fully in Locking Ring "C".

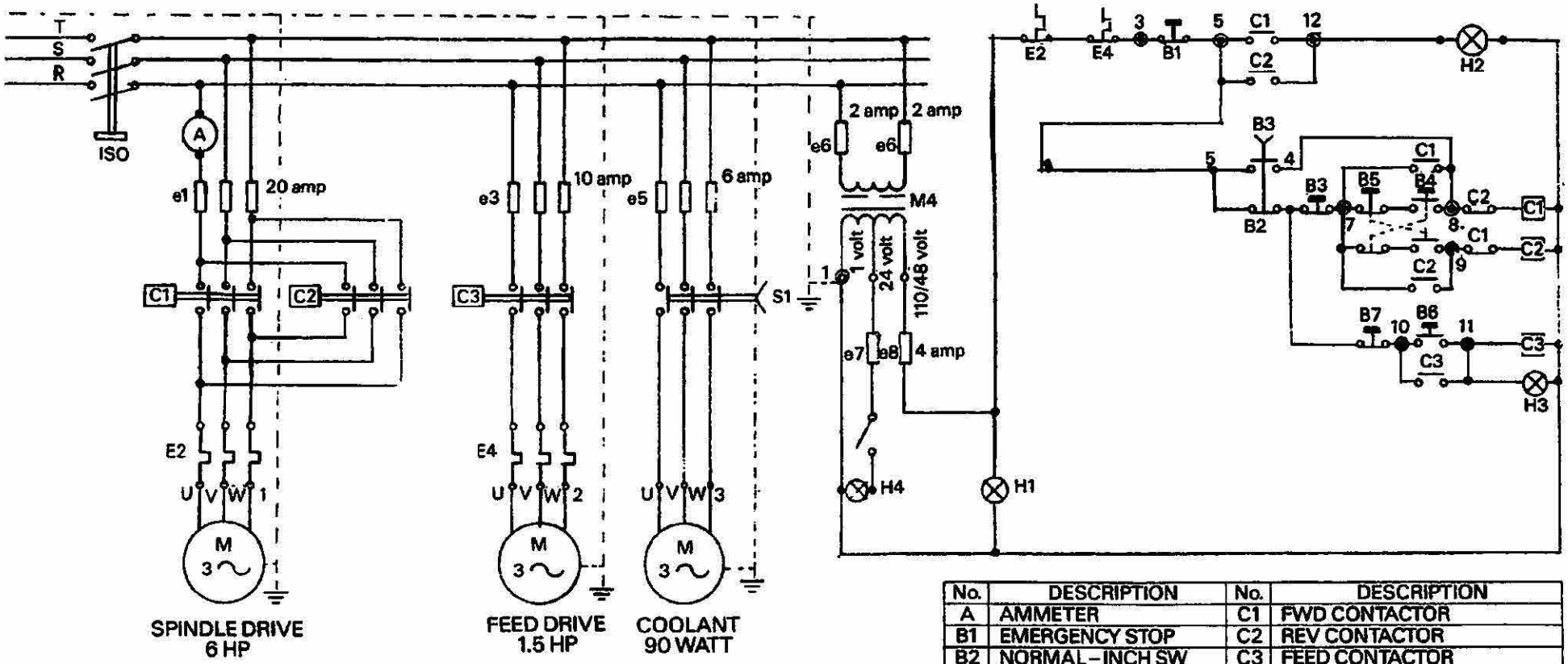
5) Replace Cover 16 — Fig. 2.



Electrical Wiring Diagram for "AJAX"
No. 3 & No. 4 Universal Milling Machines.

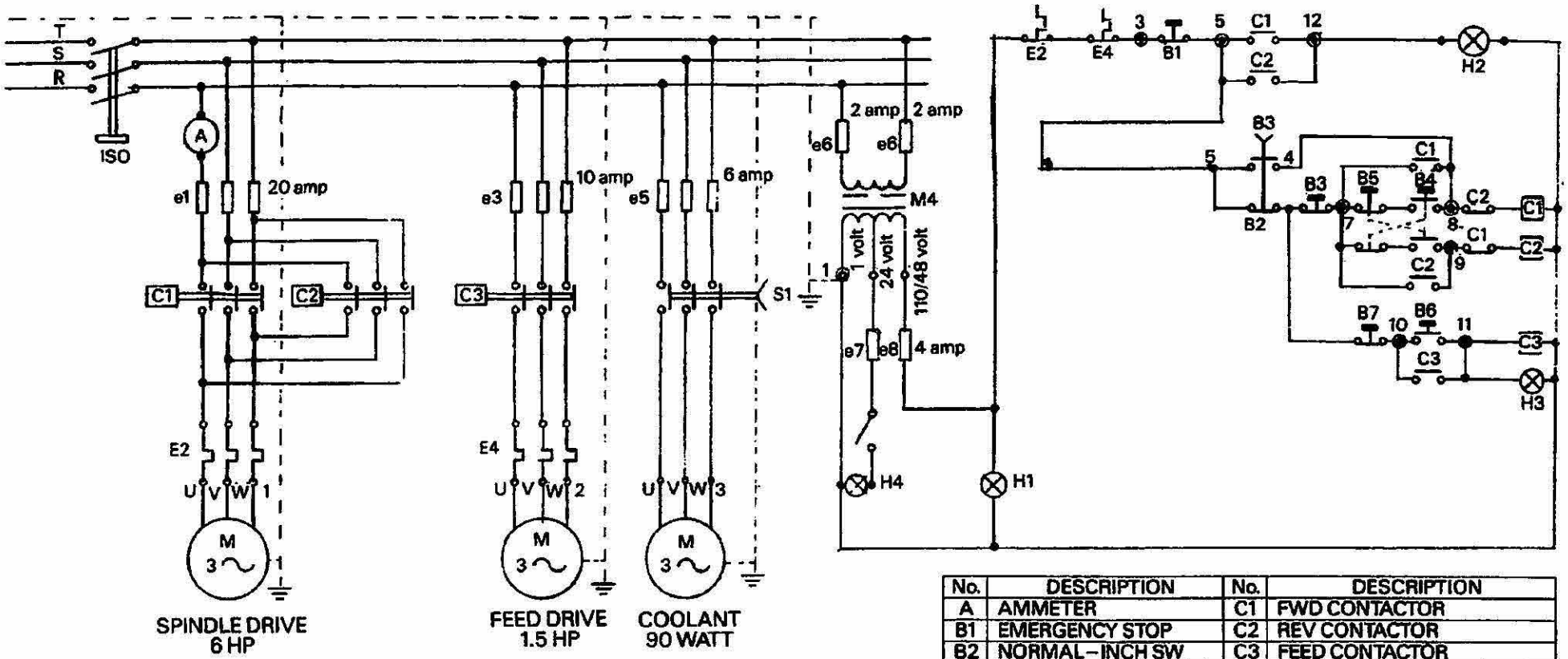


Electrical Wiring Diagram for "AJAX"
No. 3 & No. 4 Universal Milling Machines.



No.	DESCRIPTION	No.	DESCRIPTION
A	AMMETER	C1	FWD CONTACTOR
B1	EMERGENCY STOP	C2	REV CONTACTOR
B2	NORMAL – INCH SW	C3	FEED CONTACTOR
B3	SPINDLE STOP	H1	MAINS ON INDICATING LAMP
B4	SPINDLE START FOR	H2	SPINDLE INDICATING LAMP
B5	SPINDLE START REV	H3	FEED ON INDICATING LAMP
B6	FEED START	H4	MACHINE LIGHT 24 VOLT
B7	FEED STOP	ISO	ISOLATOR DOOR INTERLOCK
e1	3 – 20 AMP FUSES	S1	PUMPS ON – OFF SW
e3	3 – 10 AMP FUSES		
e5	3 – 6 AMP FUSES	M4	TRANSFORMER
e6	2 – 2 AMP FUSES		PRIMARY
e7	1 – 4 AMP FUSES		220 380 415 VOLT
e8	1 – 4 AMP FUSES		SECONDARY
			0 Volt 24 Volt 48 Volt/110 Volt
E2	SPINDLE OVERLOAD		
E4	FEED OVERLOAD		

ELECTRICAL WIRING DIAGRAM FOR
'AJAX' No. 2 UNIVERSAL MILLING MACHINE



No.	DESCRIPTION	No.	DESCRIPTION
A	AMMETER	C1	FWD CONTACTOR
B1	EMERGENCY STOP	C2	REV CONTACTOR
B2	NORMAL – INCH SW	C3	FEED CONTACTOR
B3	SPINDLE STOP	H1	MAINS ON INDICATING LAMP
B4	SPINDLE START FOR	H2	SPINDLE INDICATING LAMP
B5	SPINDLE START REV	H3	FEED ON INDICATING LAMP
B6	FEED START	H4	MACHINE LIGHT 24 VOLT
B7	FEED STOP	ISO	ISOLATOR DOOR INTERLOCK
e1	3 – 20 AMP FUSES	S1	PUMPS ON – OFF SW
e3	3 – 10 AMP FUSES		
e5	3 – 6 AMP FUSES	M4	TRANSFORMER
e6	2 – 2 AMP FUSES		PRIMARY
e7	1 – 4 AMP FUSES		220 380 415 VOLT
e8	1 – 4 AMP FUSES		SECONDARY
			0 Volt 24 Volt 48 Volt/110 Volt
E2	SPINDLE OVERLOAD		
E4	FEED OVERLOAD		

ELECTRICAL WIRING DIAGRAM FOR
'AJAX' No. 2 UNIVERSAL MILLING MACHINE

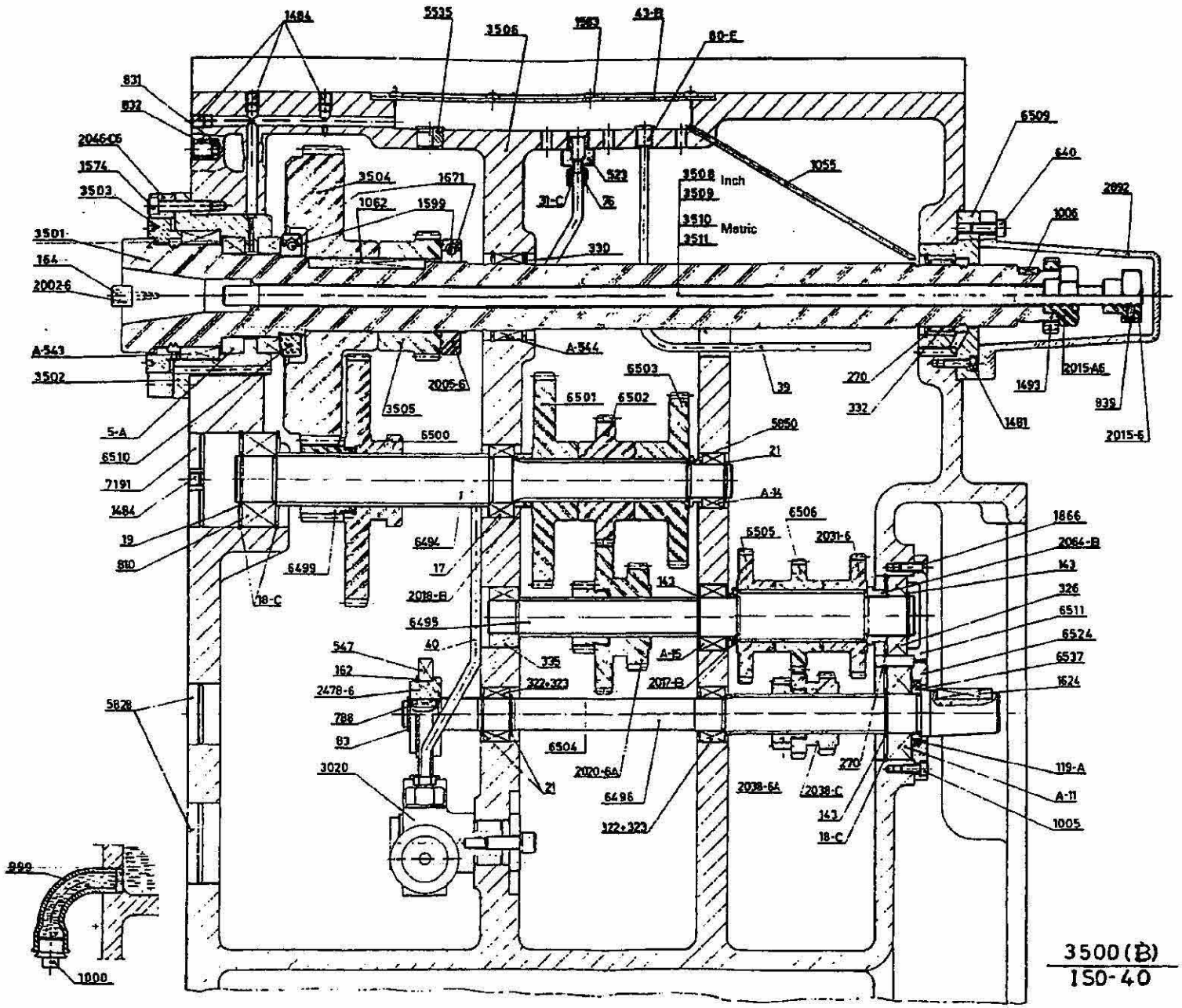
No.2, No.3 & No.4

CLEVELAND UNIVERSAL MILLING MACHINES

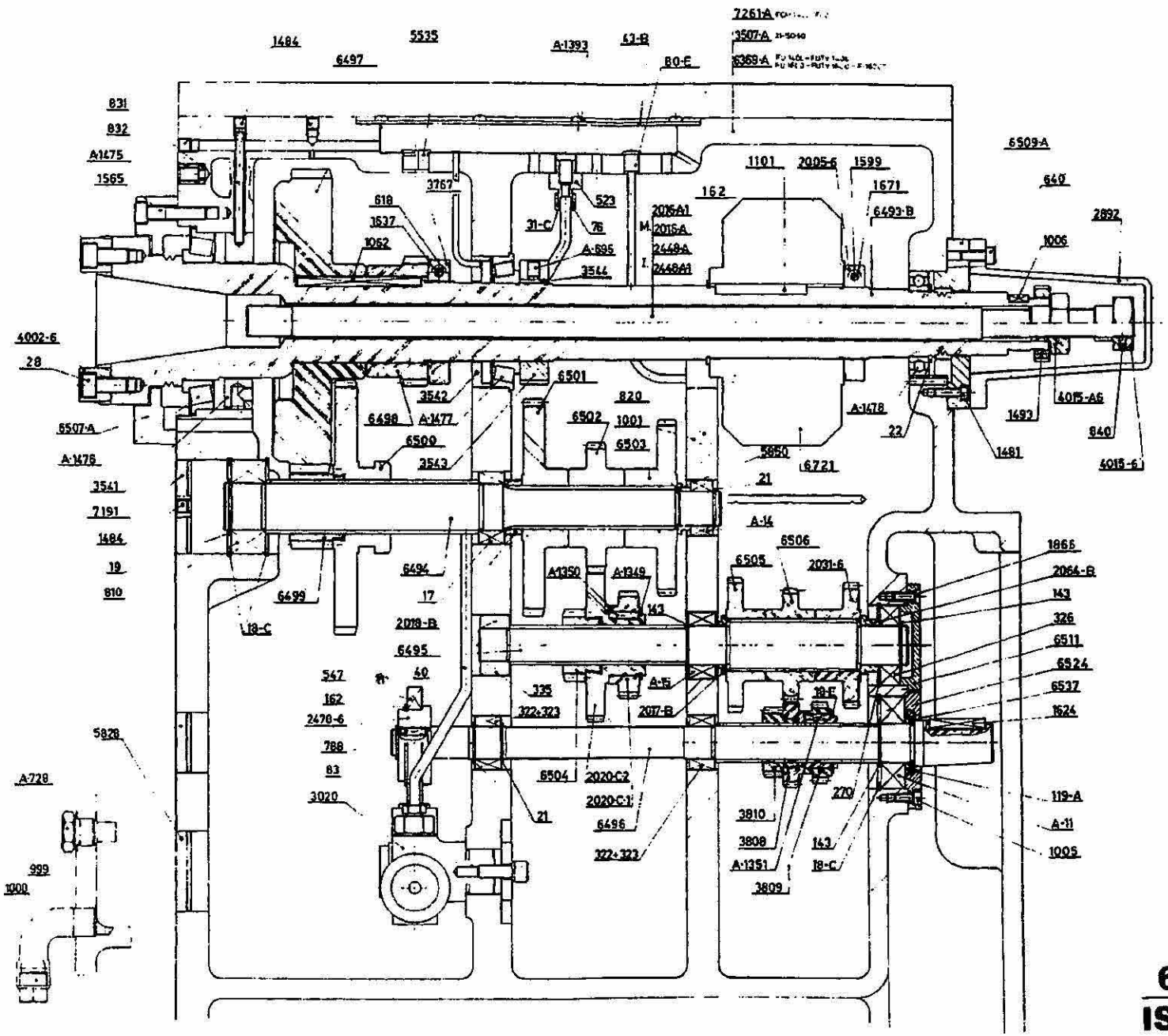
Spare Parts Manual

INDEX

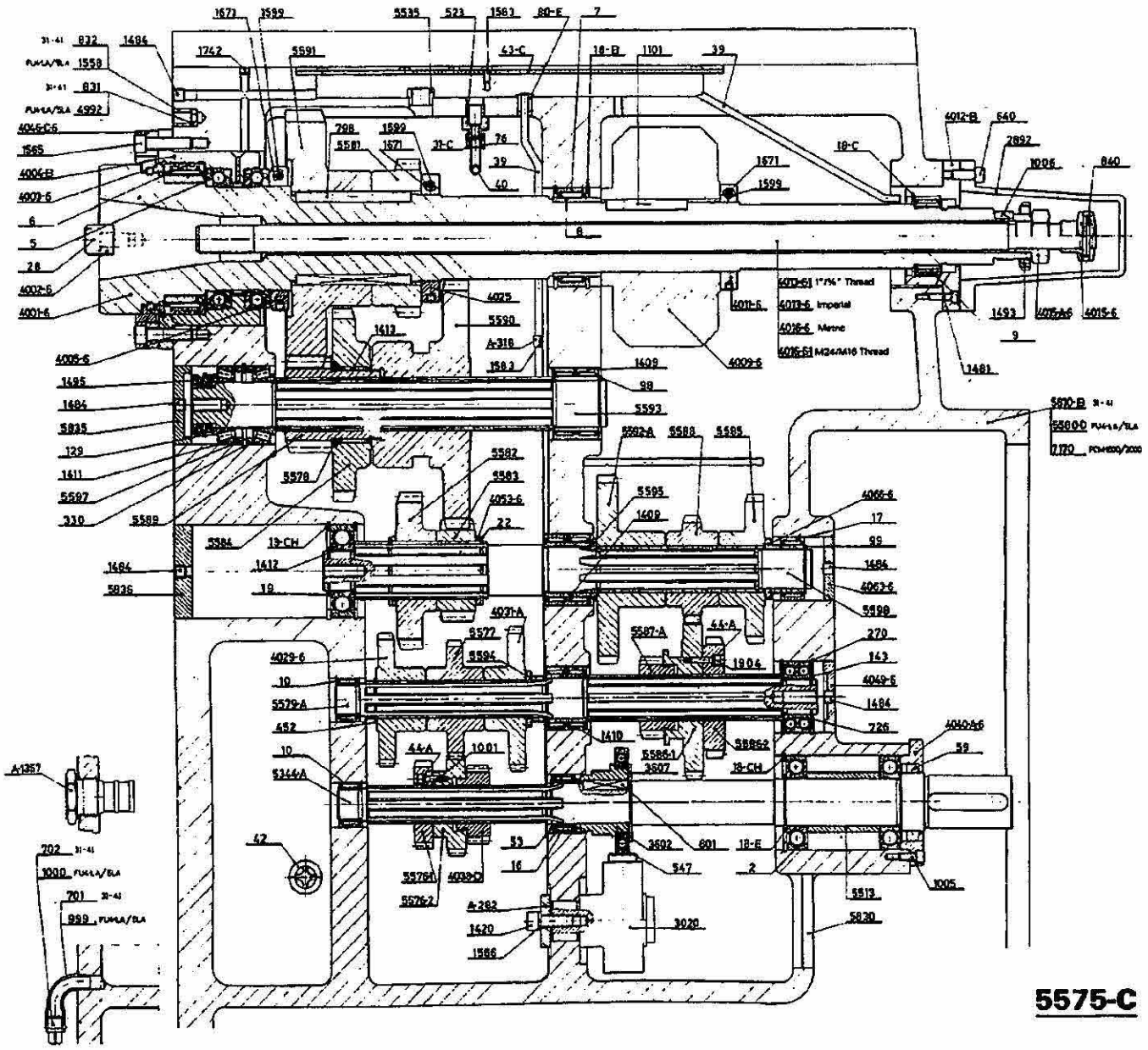
See page 36 for procedure for ordering spare parts.

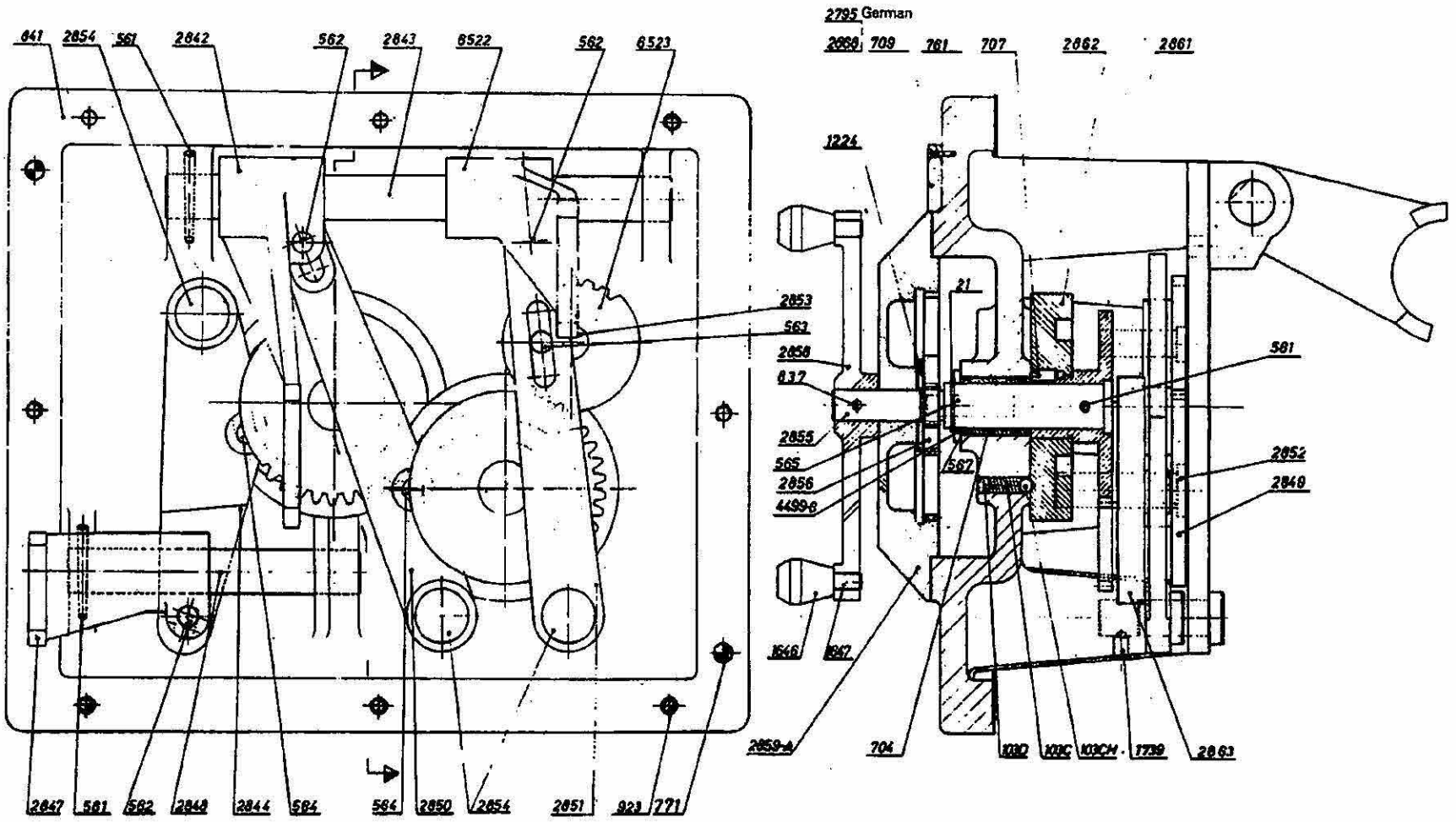

1484
5535
3506
1583
42-B
80-E
831
832
2046-C6
1574
3503
3501
164
20026
A-543
3502
5-A
6510
7191
1484
19
810
3504
1671
1062
1599
3505
6500
2005-6
6499
18-C
6494
17
2018-B
6499
40
547
162
2478-6
788
83
3020
5828
999
1000
31-C
523
75
330
3508 Inch
3509
3510 Metric
3511
1055
6509
640
2092
1006
A-544
6503
6501
6502
39
5850
21
A-14
6506
6505
2031-6
143
326
6511
6524
6537
1624
1866
2064-B
A-15
335
372+373
2017-B
6504
2020-6A
6496
372+373
21
2038-6A
2038-C
270
143
18-C
119-A
A-11
1005
270
332
1493
1481
2015-A6
939
2015-6

3500(B)
150-40

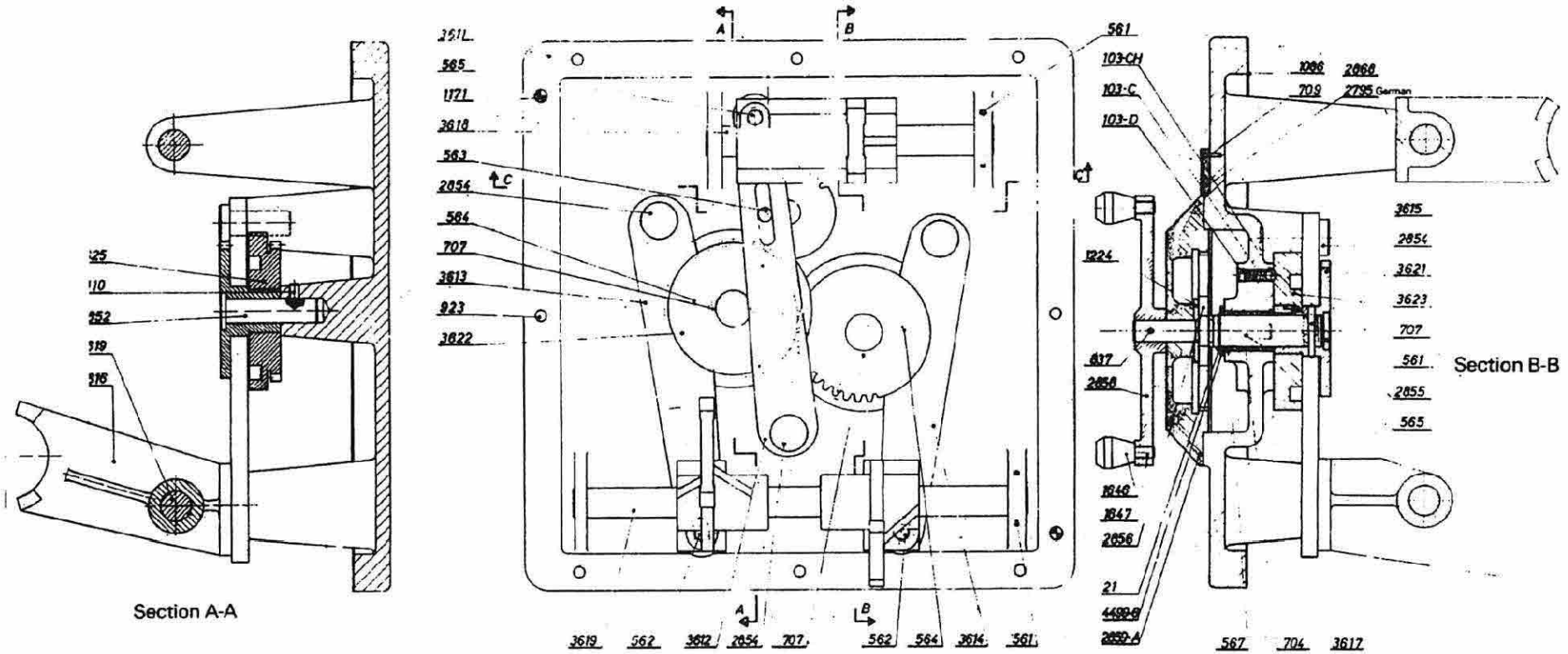

7261-A
3507-A
6369-A
1484
5535
6497
A-1393
61-B
80-E
831
832
A1475
1565
3767
618
1637
1062
523
76
A-695
3544
31-C
2016-A1
2016-A
2448-A
2448A1
1101
2005-6
1599
1671
6493-B
162
6509-A
649
2892
1006
4002-6
28
6501
3542
6498
A-1477
6500
3543
820
6502
1001
6503
A-1478
22
1493
4015-A6
840
4015-6
1481
6507-A
A-1476
3541
7191
1484
19
810
5850
6721
21
A-14
6506
6505
2031-6
1865
2064-B
143
326
6511
6524
6537
1624
6494
17
2018-B
6495
40
6499
18-C
A1350
A-1349
143
547
162
2470-6
788
83
3020
335
322+323
A-15
2017-B
18-F
5828
A-728
6504
2020-C2
2020-C1
6496
322+323
21
270
3810
3808
A-1351
3809
143
18-C
119-A
A-11
1005
999
1000

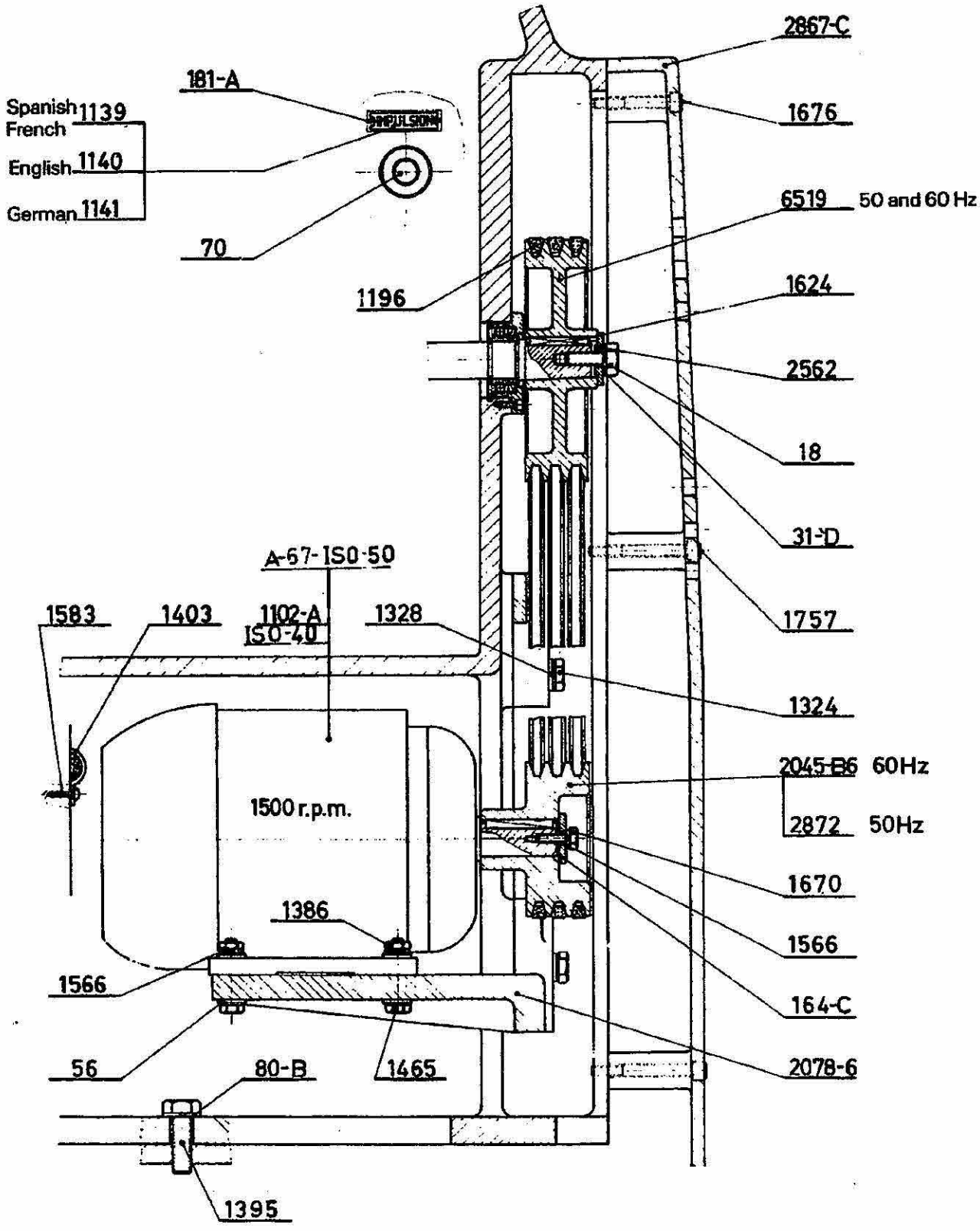
6150
ISO-50


5575-C

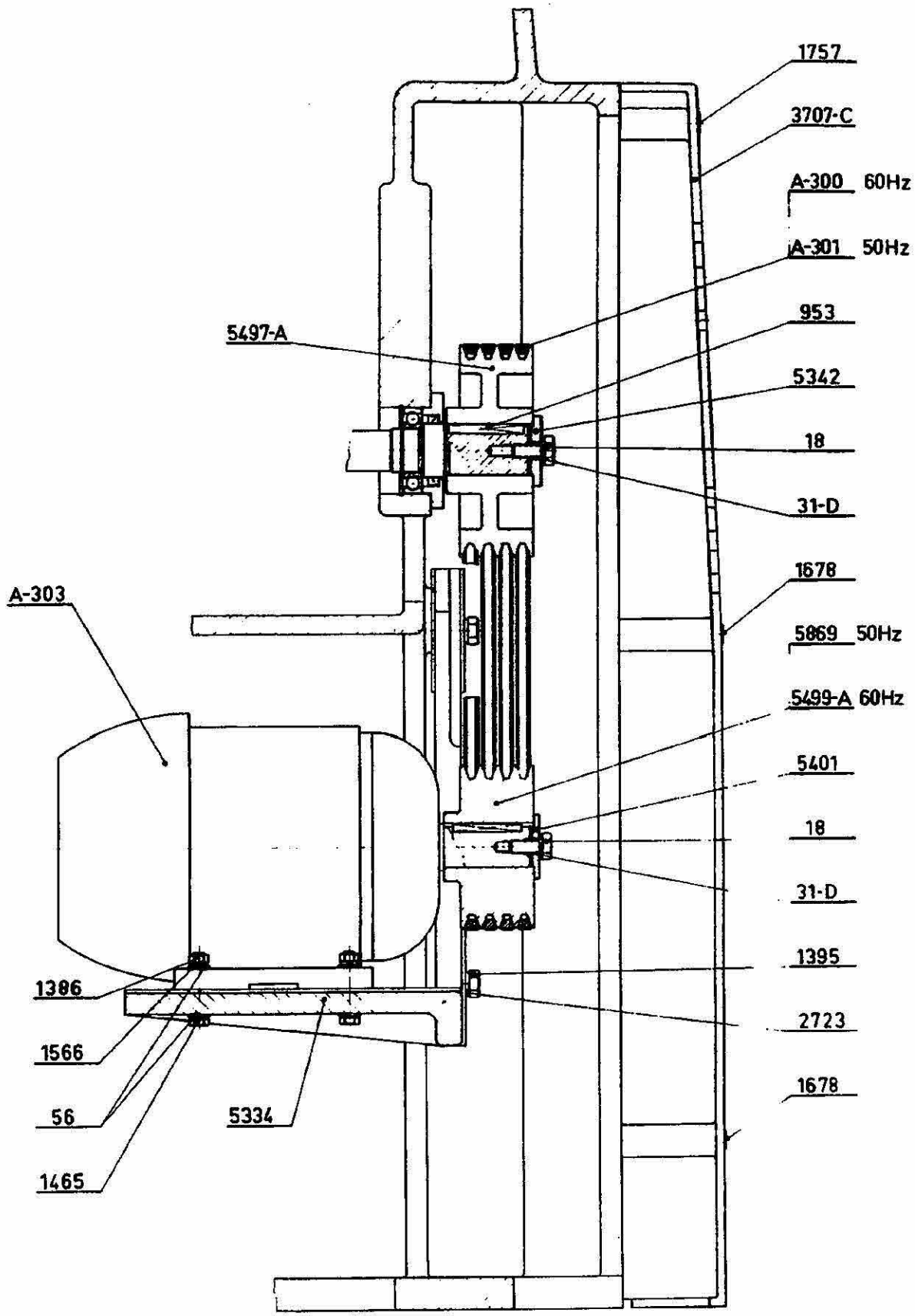

2795 German
641
2854
561
2842
562
2843
6522
562
6523
2853
563
2858
637
2855
565
2856
44996
2859-A
704
1640
1667
1224
21
709
781
707
2862
2861
581
2852
2849
567
100D
100C
100CH
7739
2863
2847
581
582
2848
2844
584
584
2850
2854
2851
923
771

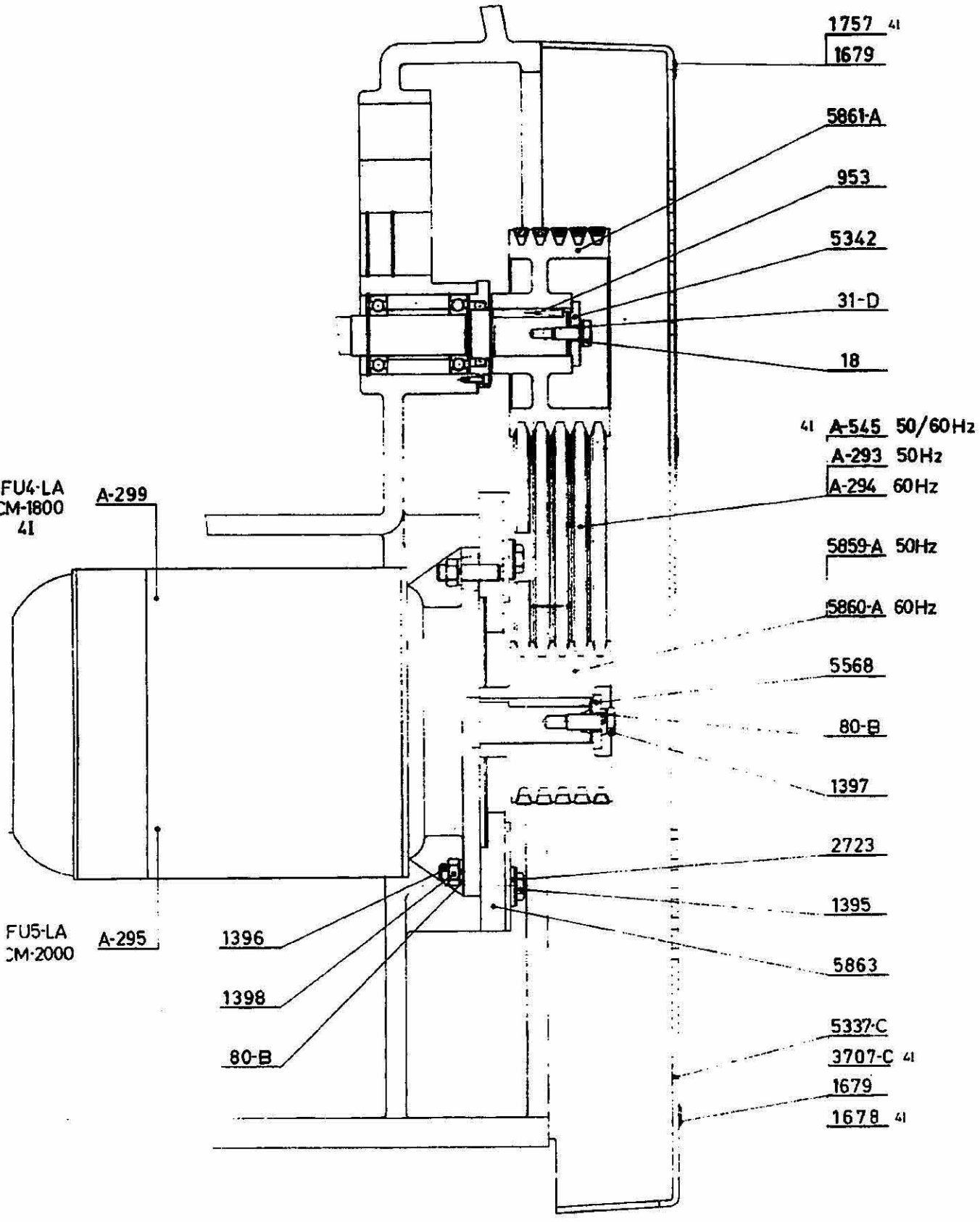
3500


Section A-A
Section B-B
Section C-C

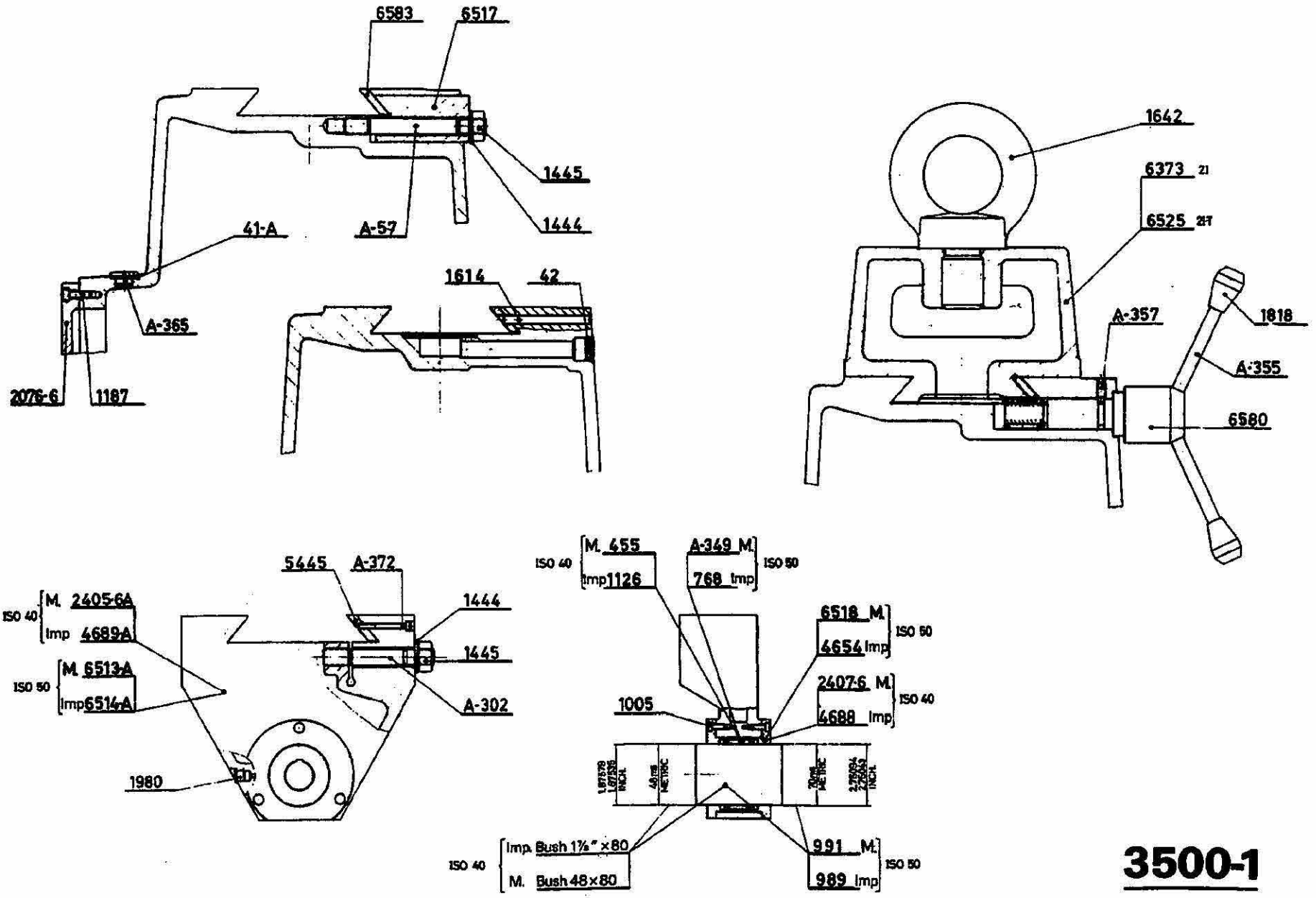

2867-C
181-A
Spanish 1139
French
English 1140
German 1141
1676
6519 50 and 60 Hz
70
1196
1624
2562
18
31-D
A-67-ISO-50
1583
1403
1102-A
ISO-40
1328
1757
1324
2045-B6 60Hz
2872 50Hz
1500 r.p.m.
1670
1386
1566
1566
164-C
56
80-B
1465
2078-6
1395

4790

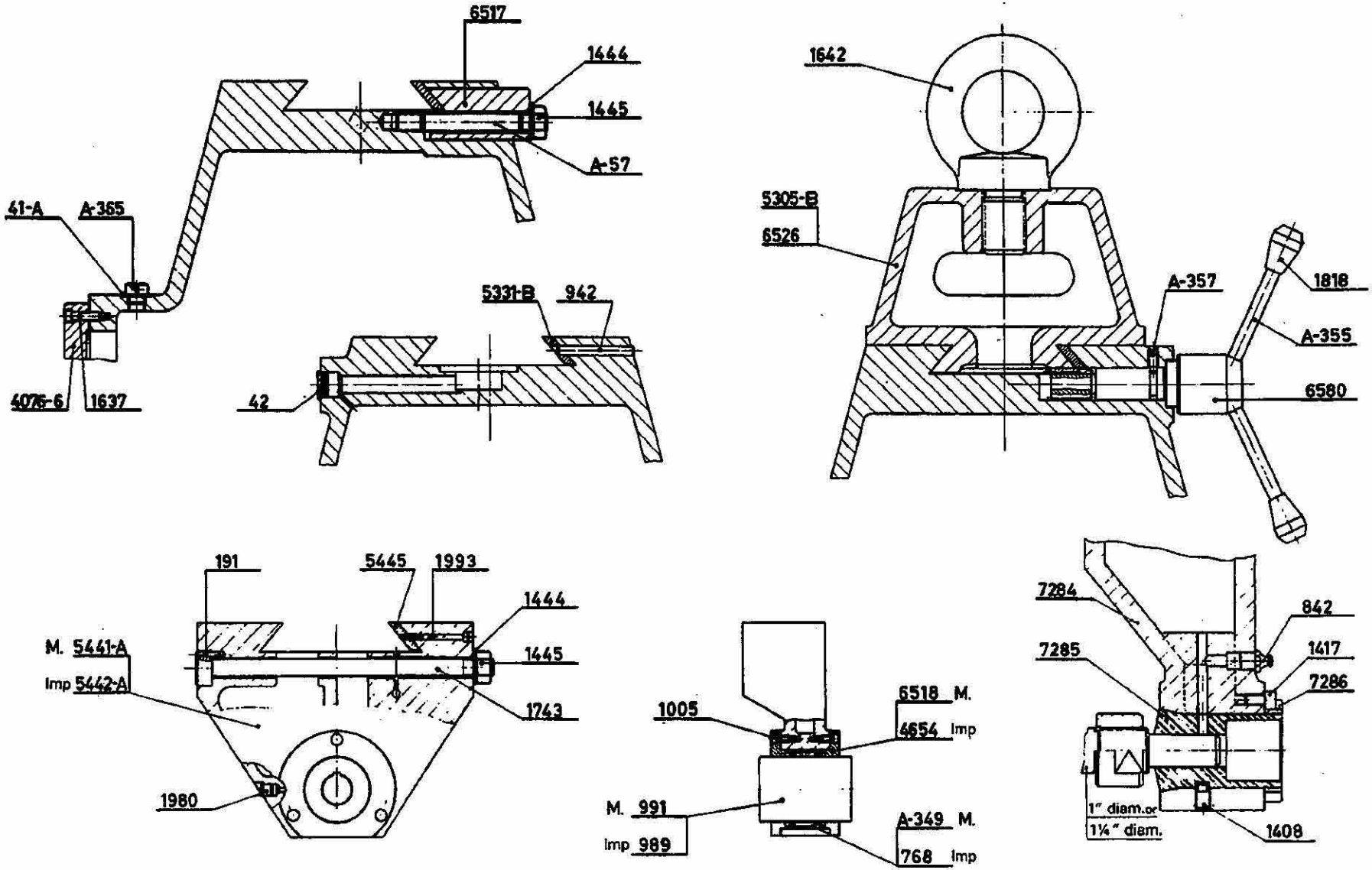

1757
3707-C
A-300 60Hz
A-301 50Hz
953
5342
18
31-D
1678
5869 50Hz
5499-A 60Hz
5401
18
31-D
1395
2723
1678
5497-A
A-303
1386
1566
56
1465
5334


1757 41
1679
5861-A
953
5342
31-D
18
41 A-545 50/60Hz
A-293 50Hz
A-294 60Hz
5859-A 50Hz
5860-A 60Hz
5568
80-B
1397
2723
1395
5863
5337-C
3707-C 41
1679
1678 41
FU4-LA
FCM-1800
41
A-299
FU5-LA
CM-2000
A-295
1396
1398
80-B

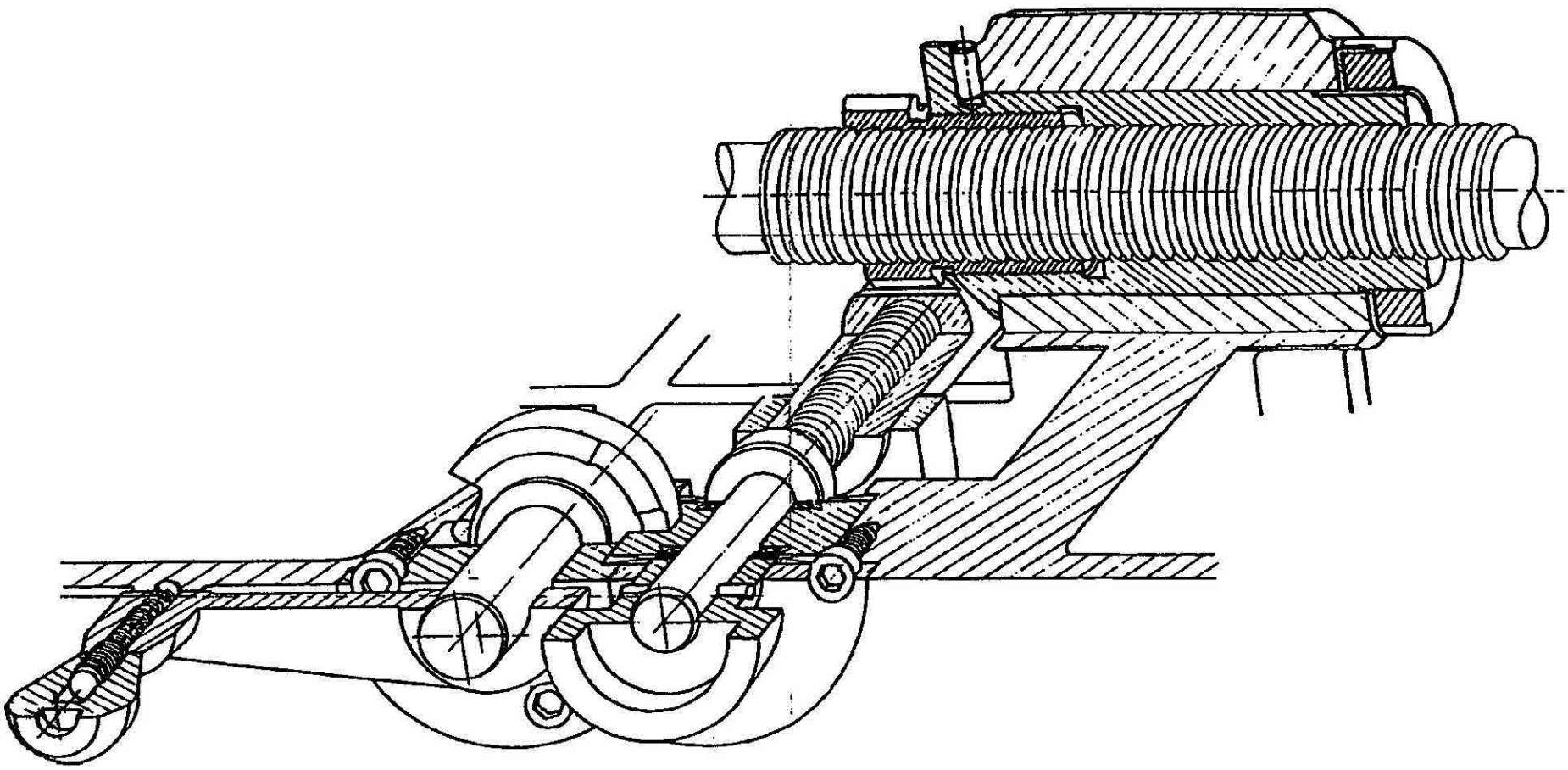
5200


6583
6517
1445
1444
41-A
A-57
A-365
2076-6
1187
1614
42
1642
6373 21
6525 21
A-357
1818
A-355
6580
5445
A-372
1444
1445
A-302
ISO 40 M. 2405-6A Imp 4689A
ISO 50 M. 6513A Imp 6514A
1980
ISO 40 M. 455 Imp 1126
A-349 M. 768 Imp ISO 50
6518 M. 4654 Imp ISO 50
2407-6 M. 4688 Imp ISO 40
1005
ISO 40 Imp. Bush 1⅞" × 80 M. Bush 48 × 80
991 M. 989 Imp ISO 50

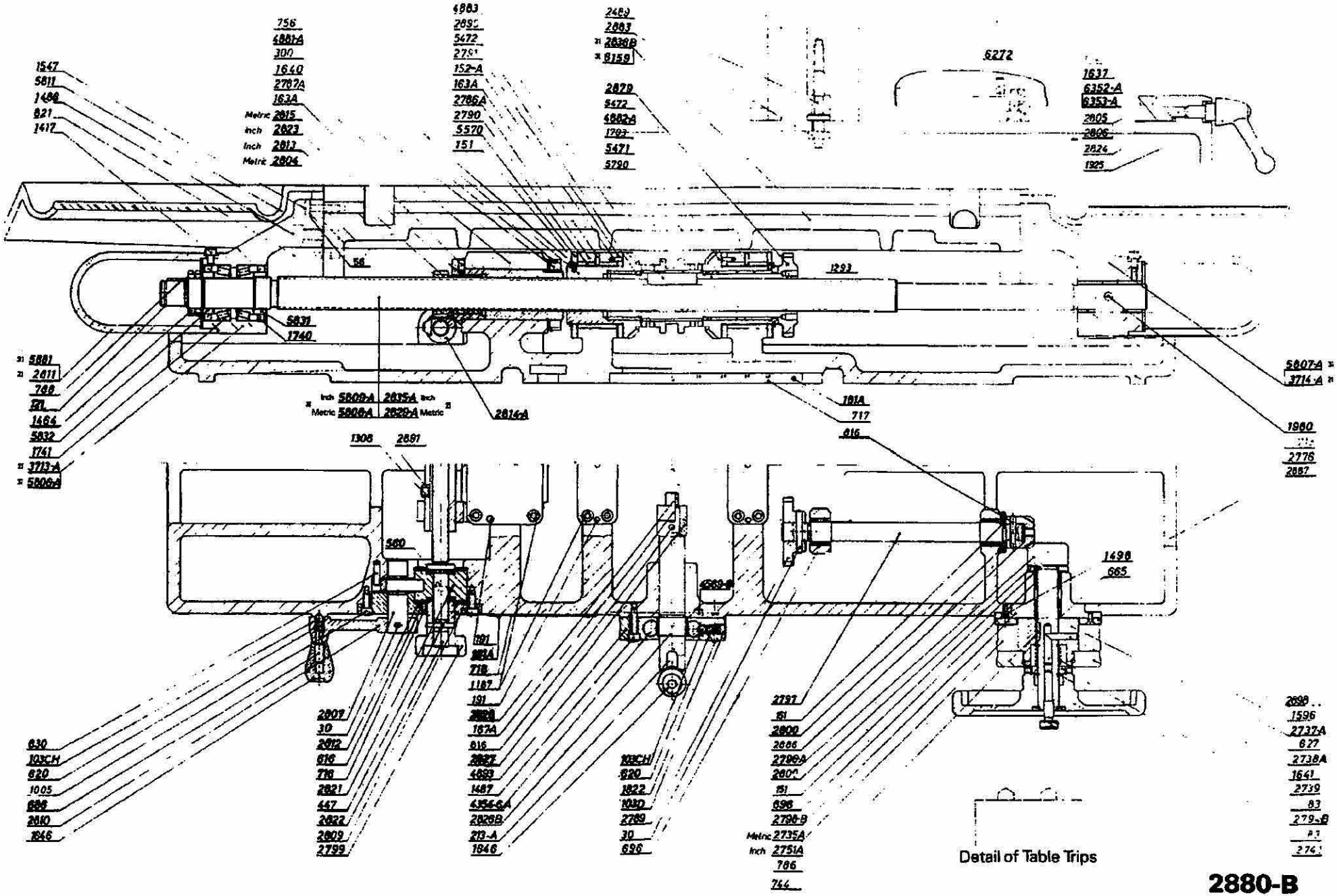
3500-1


6517
1444
1445
A-57
41-A
A-365
4076-6
1637
5331-B
942
42
1642
5305-B
6526
A-357
1818
A-355
6580
191
5445
1993
1444
M. 5441-A
Imp 5442-A
1445
1743
1980
1005
6518 M.
4654 Imp
M. 991
Imp 989
A-349 M.
768 Imp
7284
842
7285
1417
7286
1" diam.or
1¼" diam.
1408

5800-B

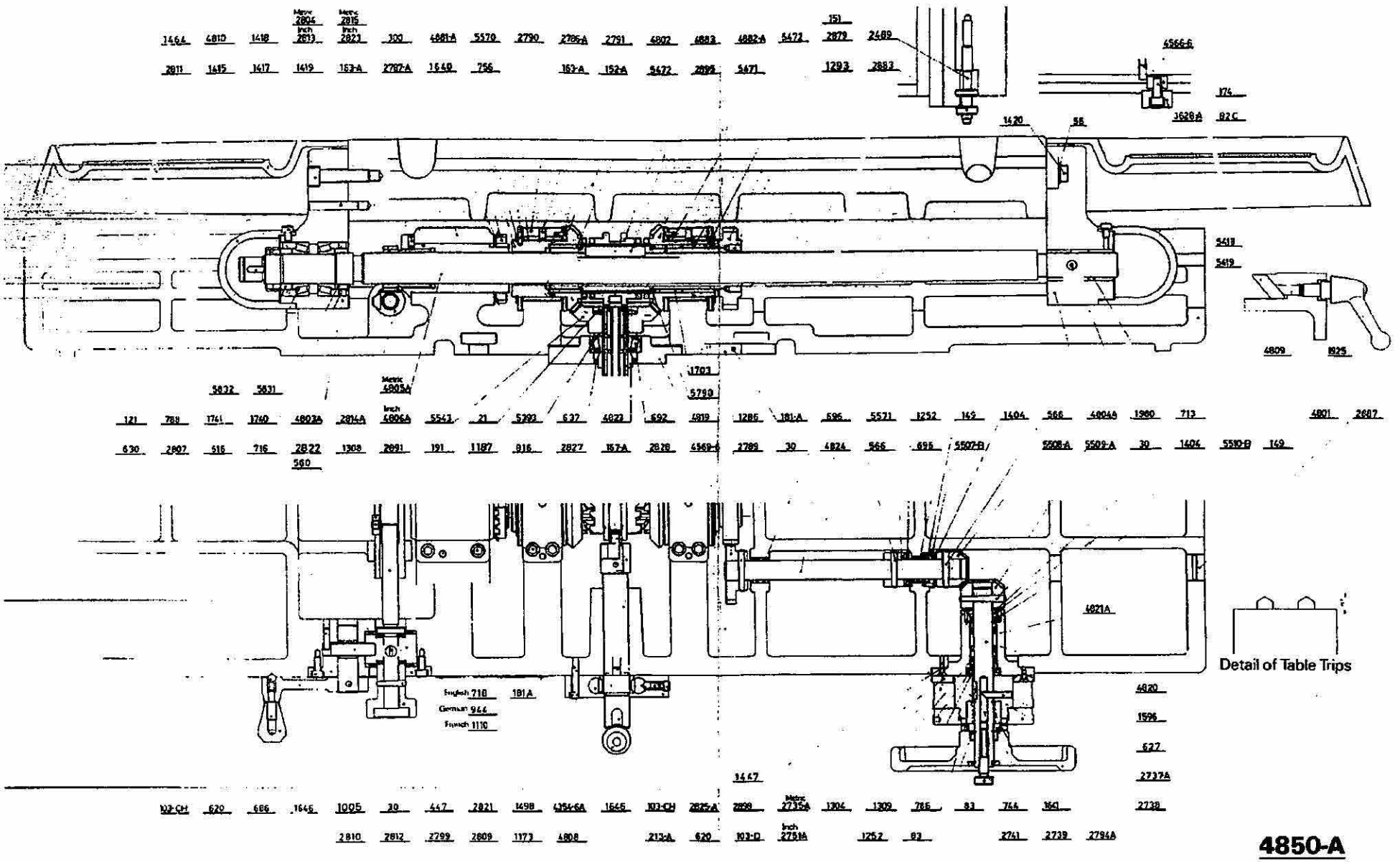


6

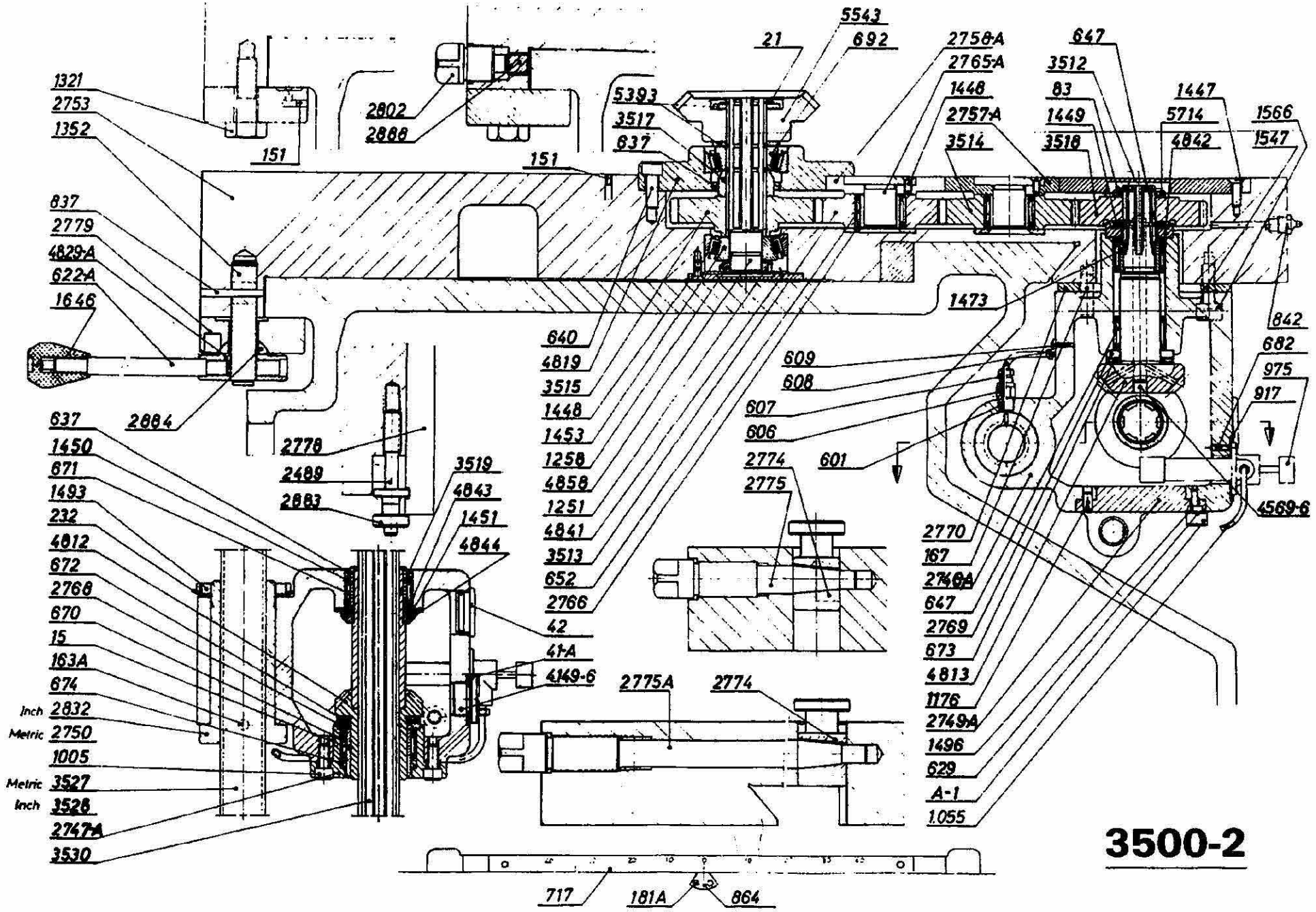


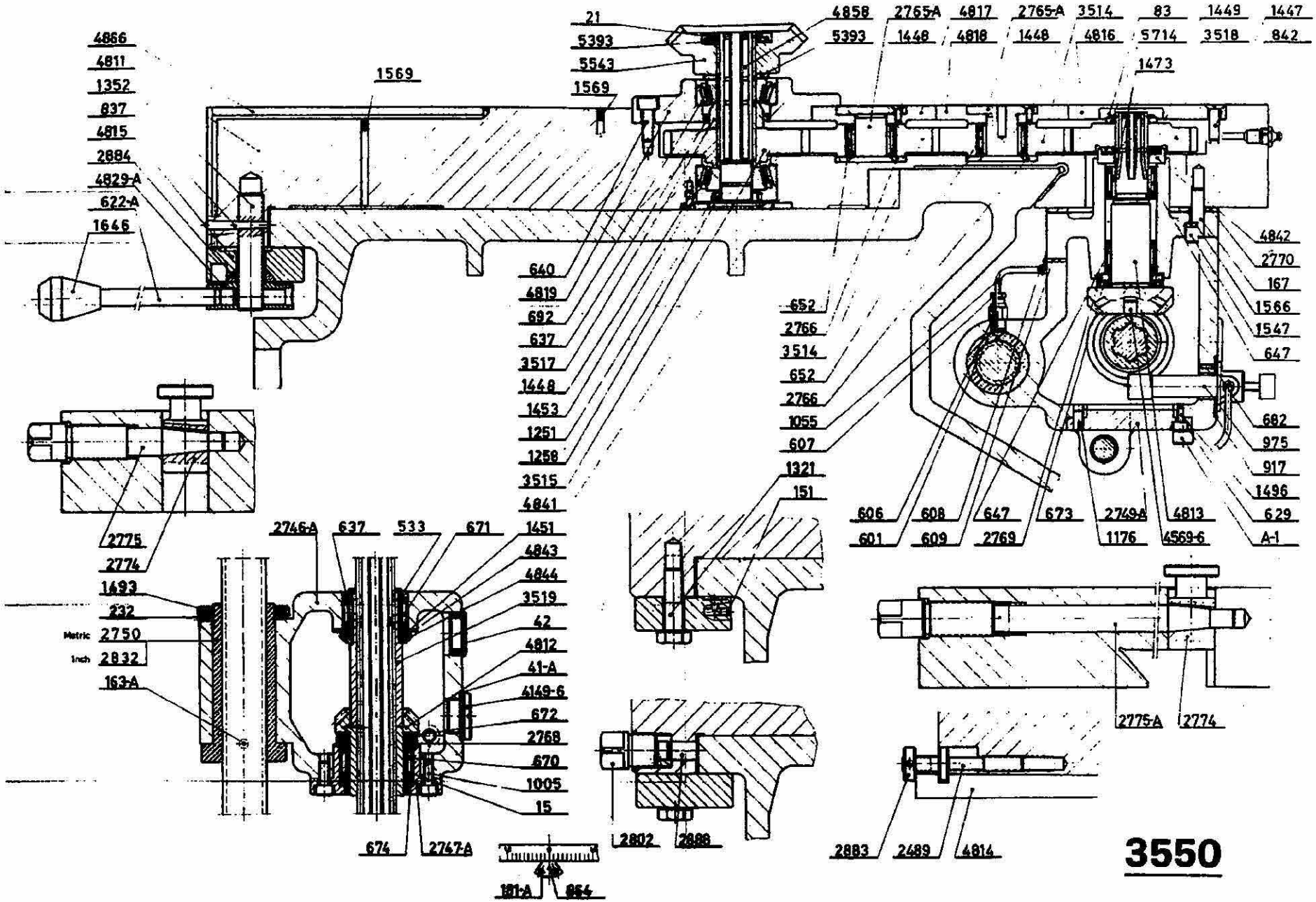
Detail of Table Trips

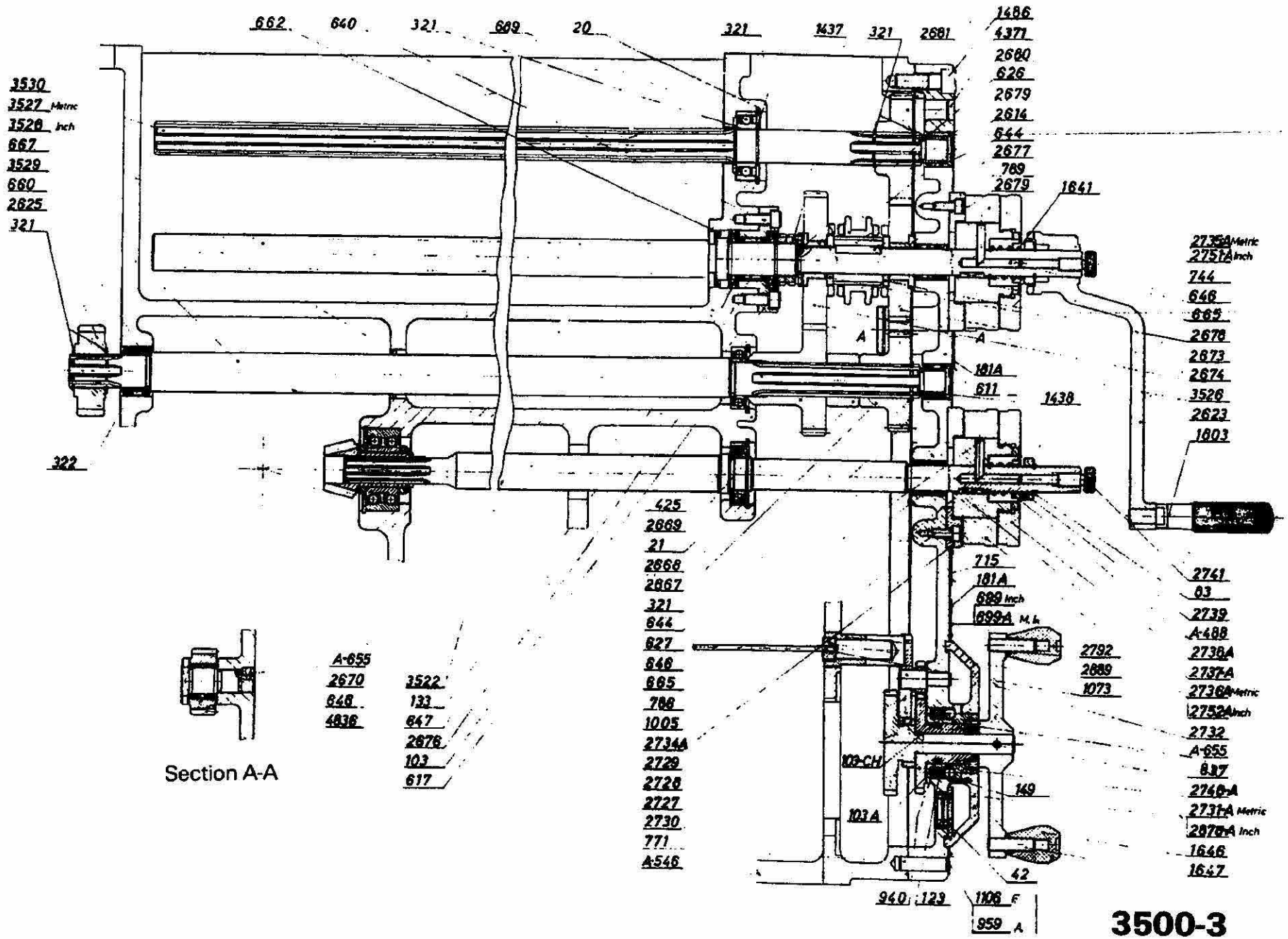
2880-B



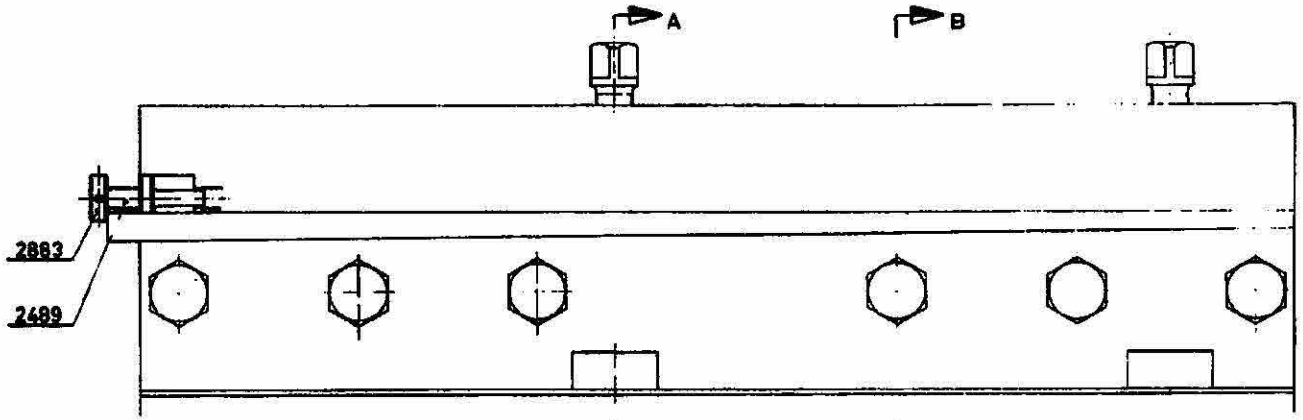
4850-A

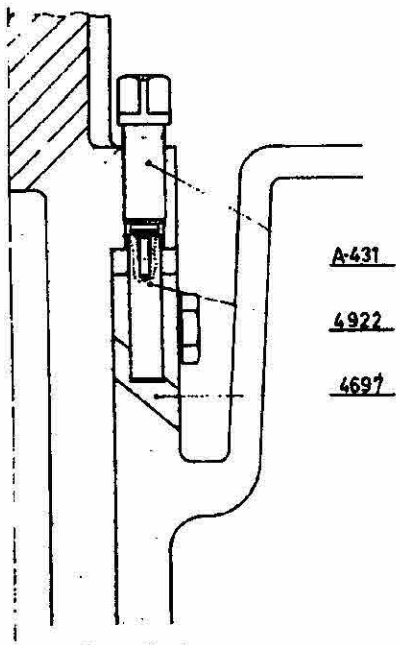

1321
2753
1352
151
2802
2888
151
5543
692
21
5393
3517
637
2758-A
2765-A
1448
2757-A
3514
647
3512
83
1449
3518
1447
5714
4842
1566
1547
837
2779
4829-A
622-A
1646
2884
640
4819
3515
1448
1453
1258
4858
1251
4841
3513
652
2766
42
41-A
4149-6
1473
842
682
975
917
609
608
607
606
601
4569-6
637
1450
671
1493
232
4812
672
2766
670
15
163A
674
Inch 2832
Metric 2750
1005
Metric 3527
Inch 3526
2747-A
3530
2778
2889
2883
3519
4843
1451
4844
2774
2775
2770
167
2760-A
647
2769
673
4813
1176
2749-A
1496
629
A-1
1.055
2775A
2774
717
181A
864
3500-2


4866
4811
1352
837
4815
2884
4829-A
622-A
1646
1569
21
5393
5543
1569
4858
5393
2765-A
1448
4817
4818
2765-A
1448
3514
4816
83
5714
1449
3518
1447
842
1473
4842
2770
167
1566
1547
647
682
975
917
1496
629
A-1
640
4819
692
637
3517
1448
1453
1251
1258
3515
4841
652
2766
3514
652
2766
1055
607
1321
151
606
601
608
609
647
2769
673
2749-A
1176
4813
4569-6
2746-A
637
533
671
1451
4843
4844
3519
42
4812
41-A
4149-6
672
2768
670
1005
15
2775
2774
1493
232
2750
2832
163-A
Metric
Inch
674
2747-A
181-A
864
2802
2888
2775-A
2774
2883
2489
4814
3550

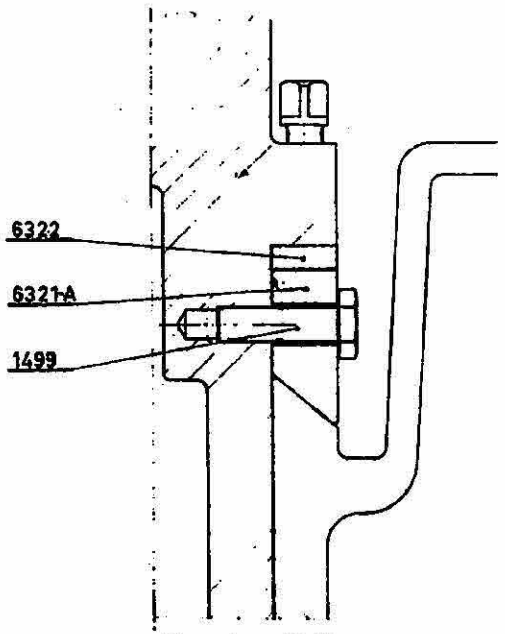

662
640
321
609
20
321
1437
321
2681
1486
4371
2680
626
2679
2614
644
2677
769
2679
1641
3530
3527 Metric
3528 Inch
667
3529
660
2625
321
322
A
A
181A
611
1438
2735A Metric
2751A Inch
744
646
665
2676
2673
2674
3526
2623
1803
425
2669
21
2668
2667
321
644
627
648
665
768
1005
2734A
2729
2728
2727
2730
771
A-546
715
181A
699 Inch
699A M.h.
2792
2689
1073
2741
83
2739
A-488
2738A
2737A
2736A Metric
2752A Inch
2732
A-655
837
2740A
2731A Metric
2870A Inch
1646
1647
A-655
2670
648
4836
3522
133
647
2676
103
617
Section A-A
103-CH
149
103A
42
940
129
1106 F
959 A

3500-3



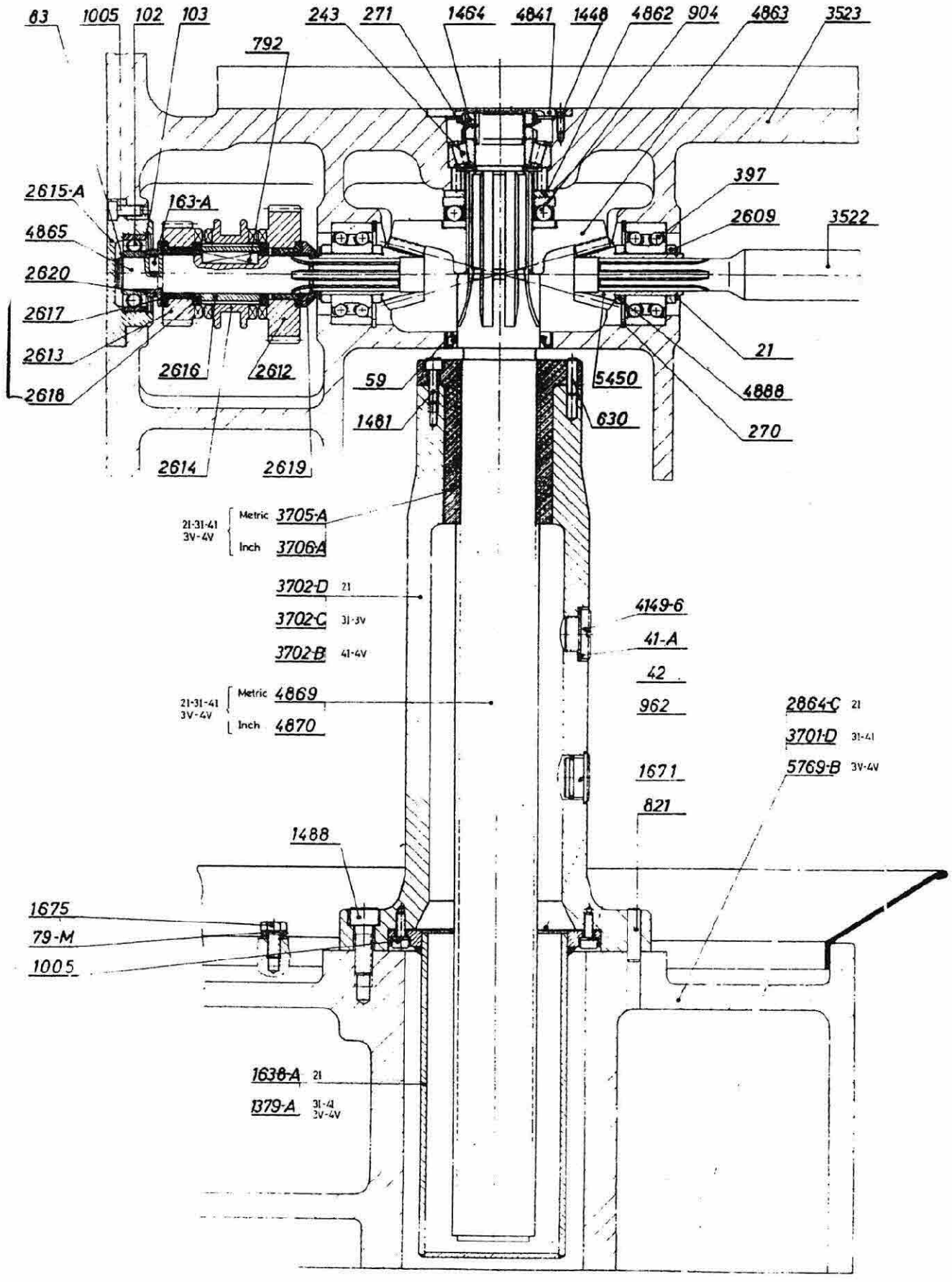


Section A-A

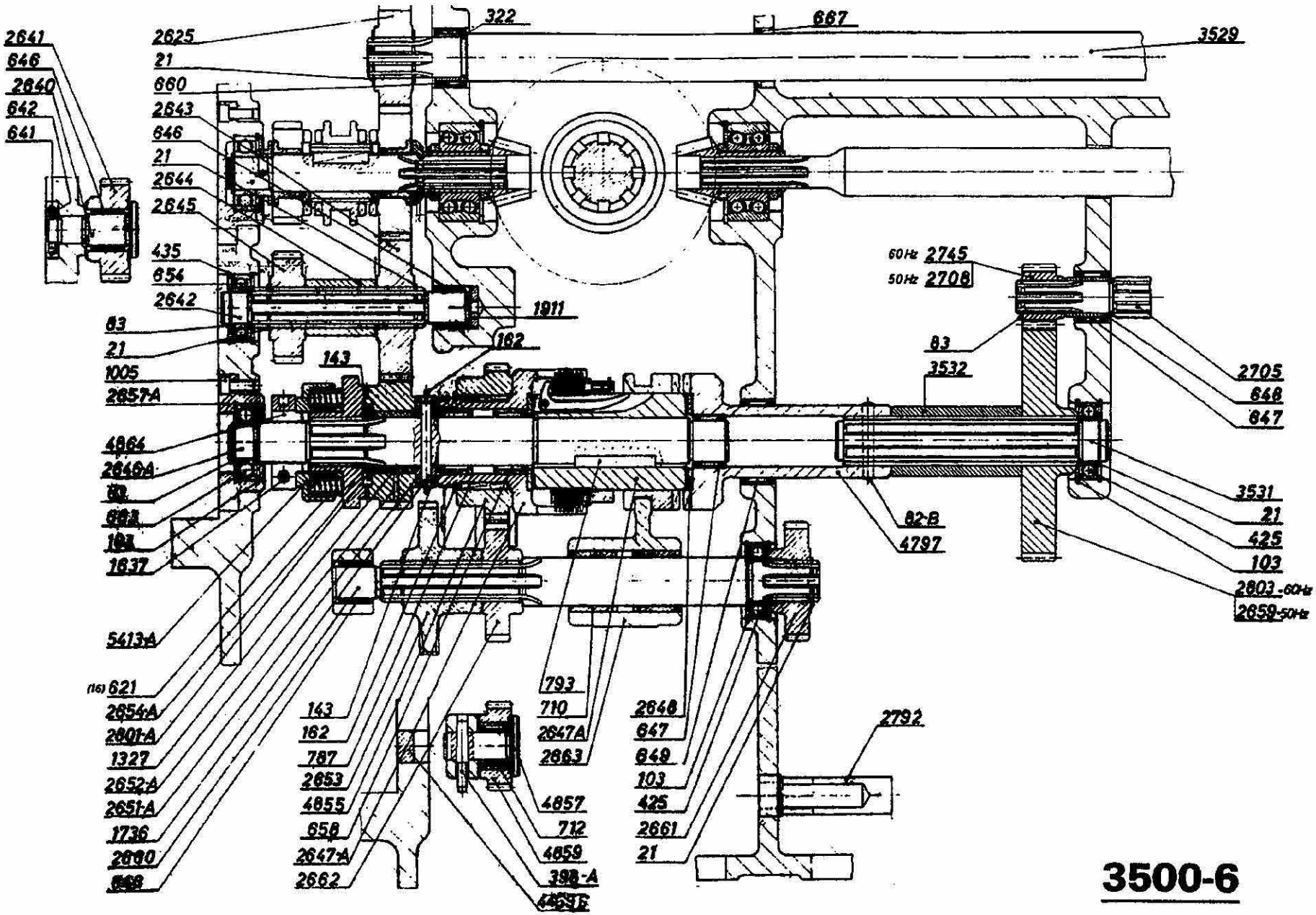


Section B-B

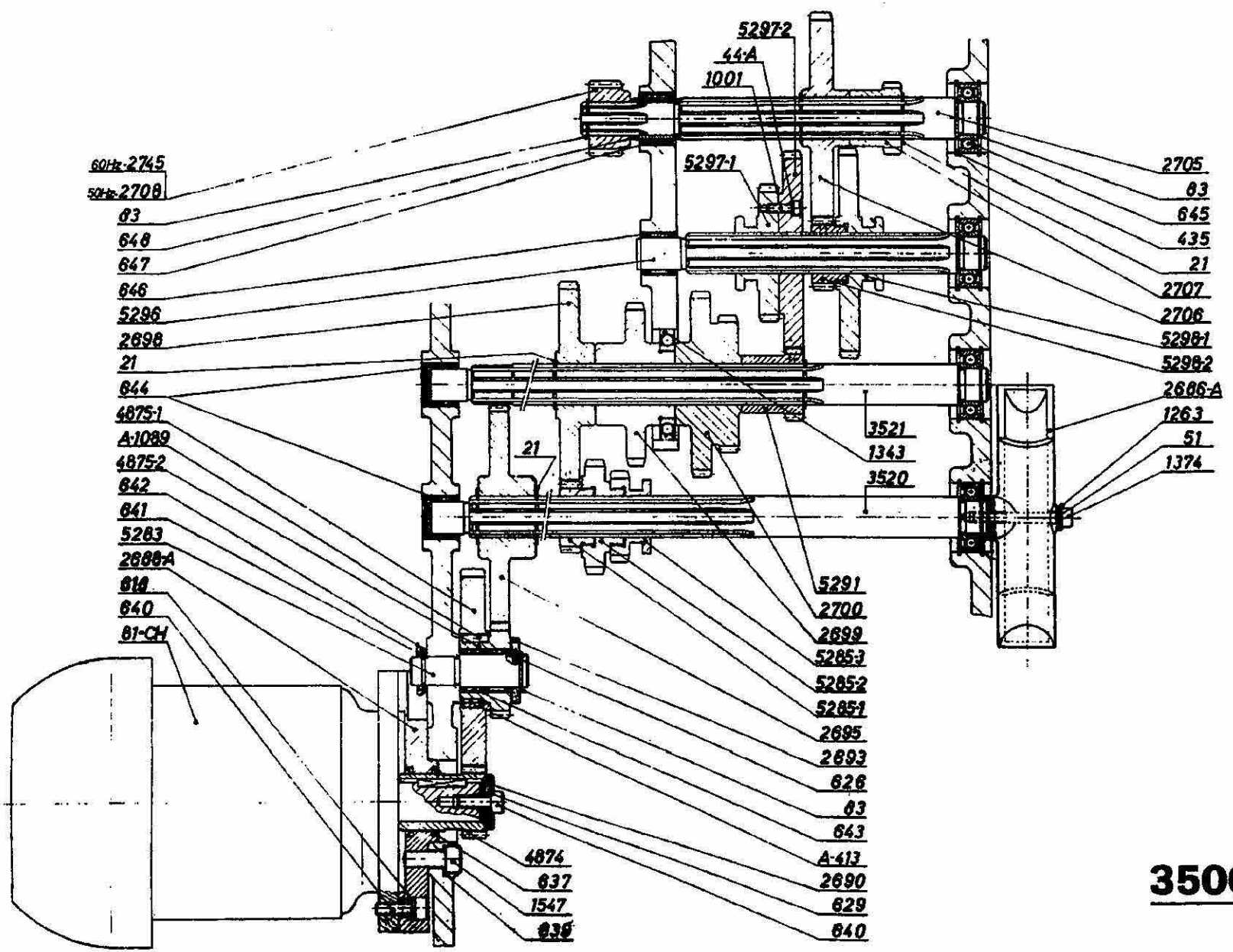
3500-4


63
1005
102
103
792
243
271
1464
4841
1448
4862
904
4863
3523
2615-A
163-A
4865
2620
2617
2613
2618
2616
2612
2614
2619
397
2609
3522
21
4888
270
59
1481
5450
630
21-31-41 3V-4V
Metric
Inch
3705-A
3706-A
3702-D 21
3702-C 31-3V
3702-B 41-4V
4149-6
41-A
42
962
1671
821
4869
4870
2864-C 21
3701-D 31-41
5769-B 3V-4V
1488
1675
79-M
1005
1638-A 21
1379-A 31-41 3V-4V

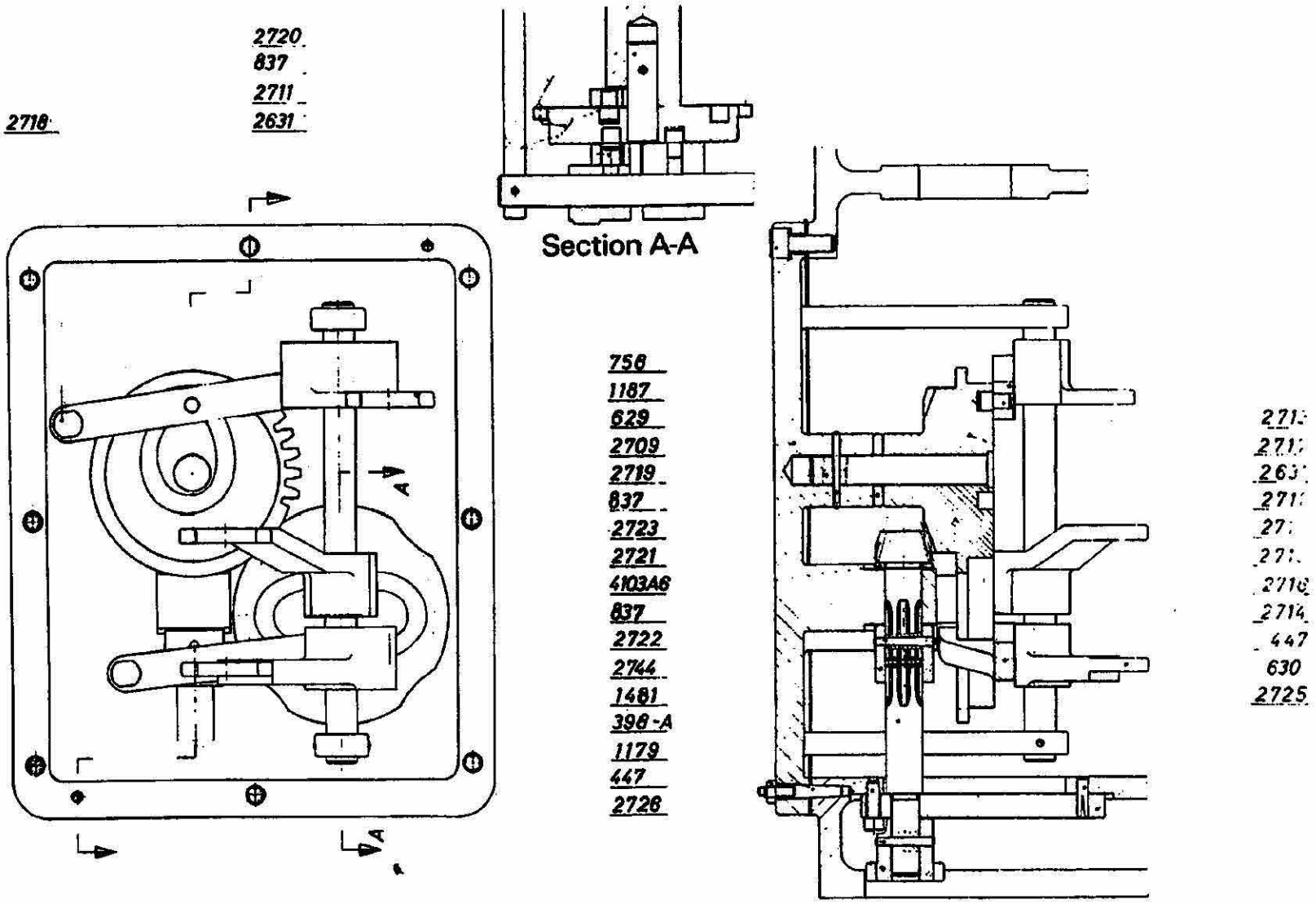
3500-5


2641
646
2640
642
641
2625
21
660
2643
646
21
2644
2645
435
654
2642
83
21
1005
2657-A
4864
2649-A
83
668
181
1637
5413-A
(16) 621
2654-A
2601-A
1327
2652-A
2651-A
1736
2660
668
322
667
3529
1911
182
143
60Hz 2745
50Hz 2708
83
3532
2705
648
647
82-B
4797
3531
21
425
103
2803-60Hz
2659-50Hz
2792
143
162
787
2653
4855
658
2647-A
2662
793
710
2647A
2663
4857
712
4859
398-A
2648
647
649
103
425
2661
21

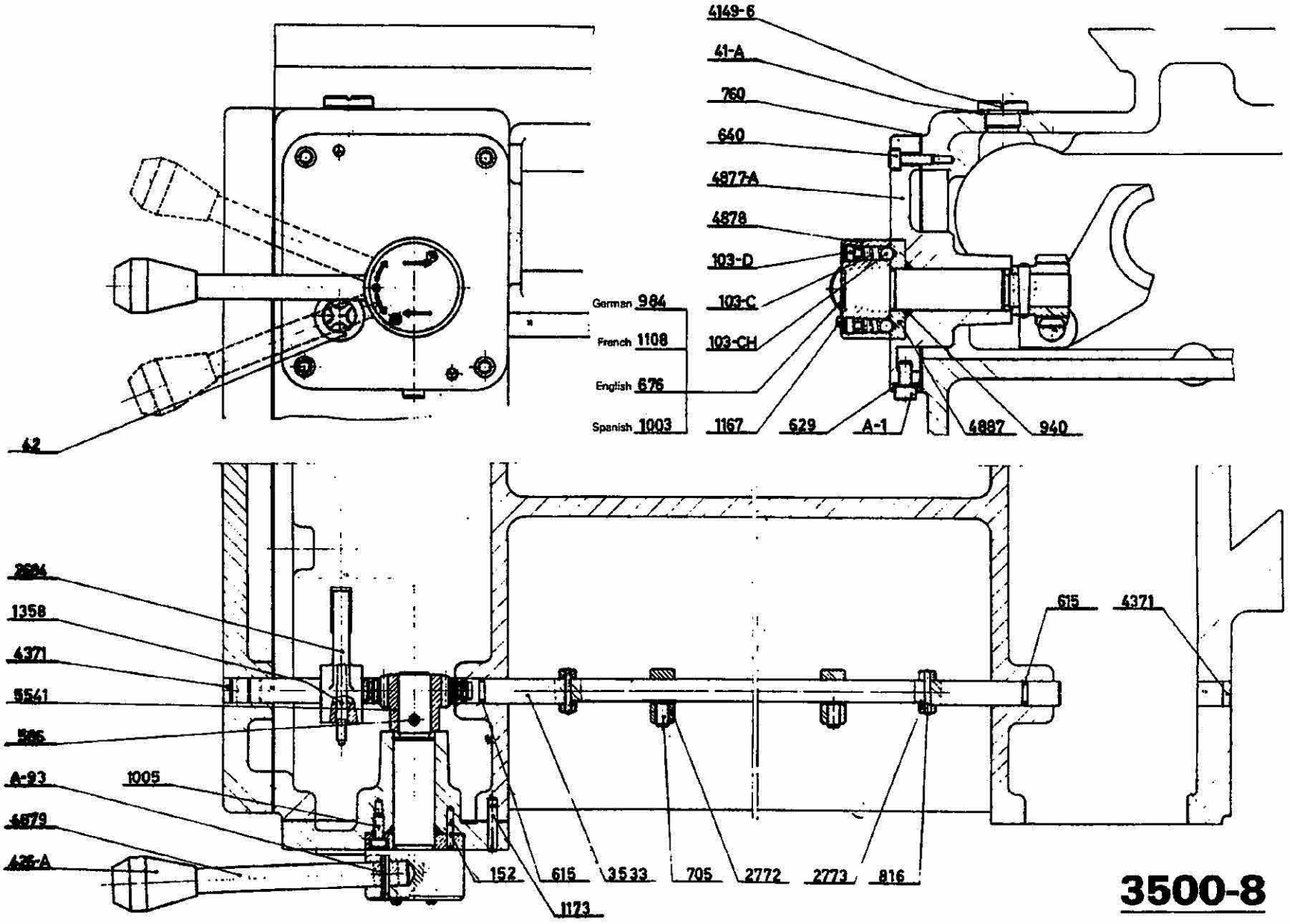
3500-6


5297-2
44-A
1001
5297-1
60Hz-2745
50Hz-2708
83
648
647
646
5296
2698
21
644
4875-1
A-1089
4875-2
642
641
5283
2688-A
618
640
81-CH
2705
83
645
435
21
2707
2706
5298-1
5298-2
2686-A
1263
51
1374
3521
1343
3520
21
5291
2700
2699
5285-3
5285-2
5285-1
2695
2693
626
83
643
A-413
2690
629
640
4874
637
1547
638

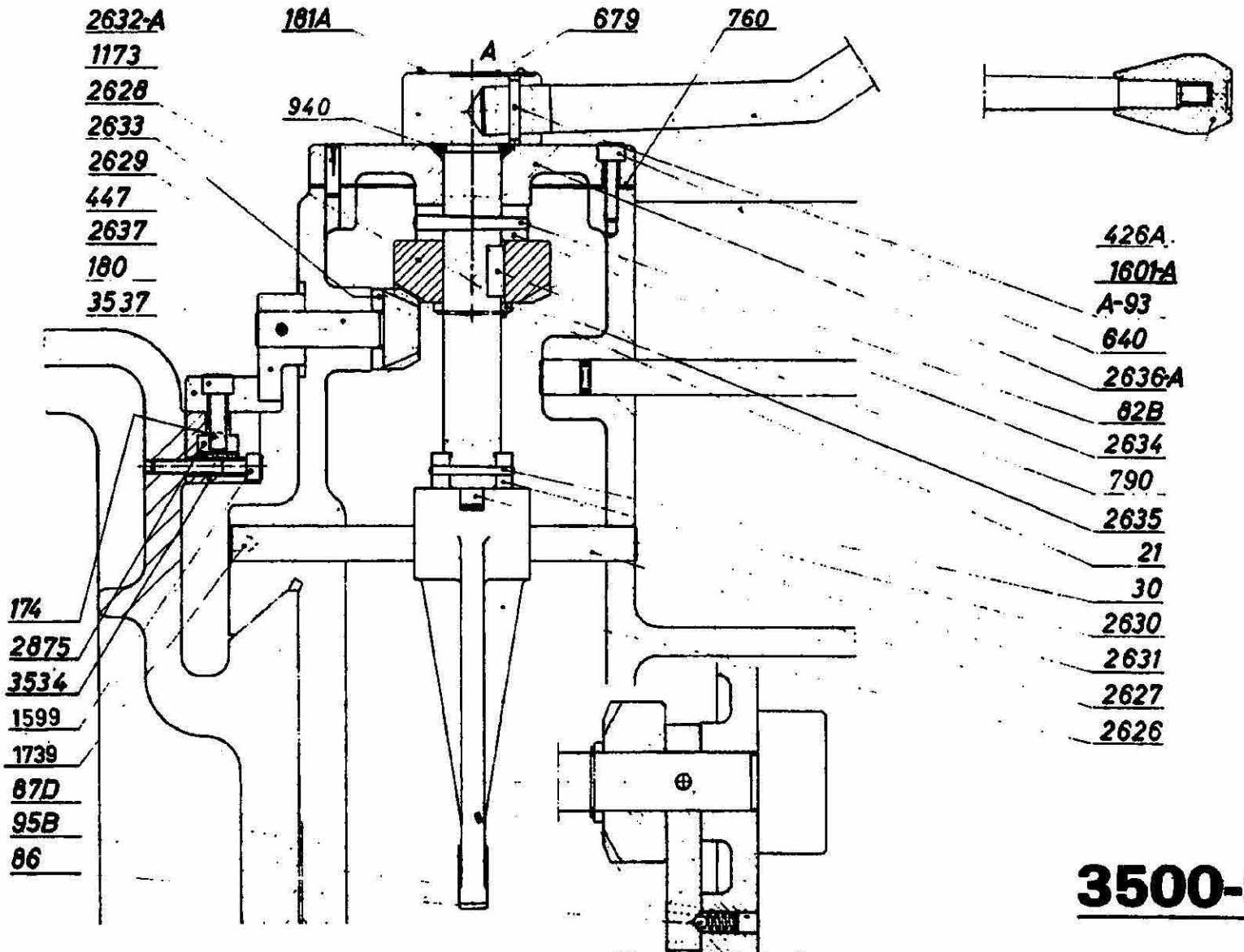
3500-7


2720
837
2711
2631
2718
Section A-A
758
1187
629
2709
2719
837
2723
2721
4103A6
837
2722
2744
1481
398-A
1179
447
2726
271
271
263
271
27
27
2710
2714
447
630
2725

2600

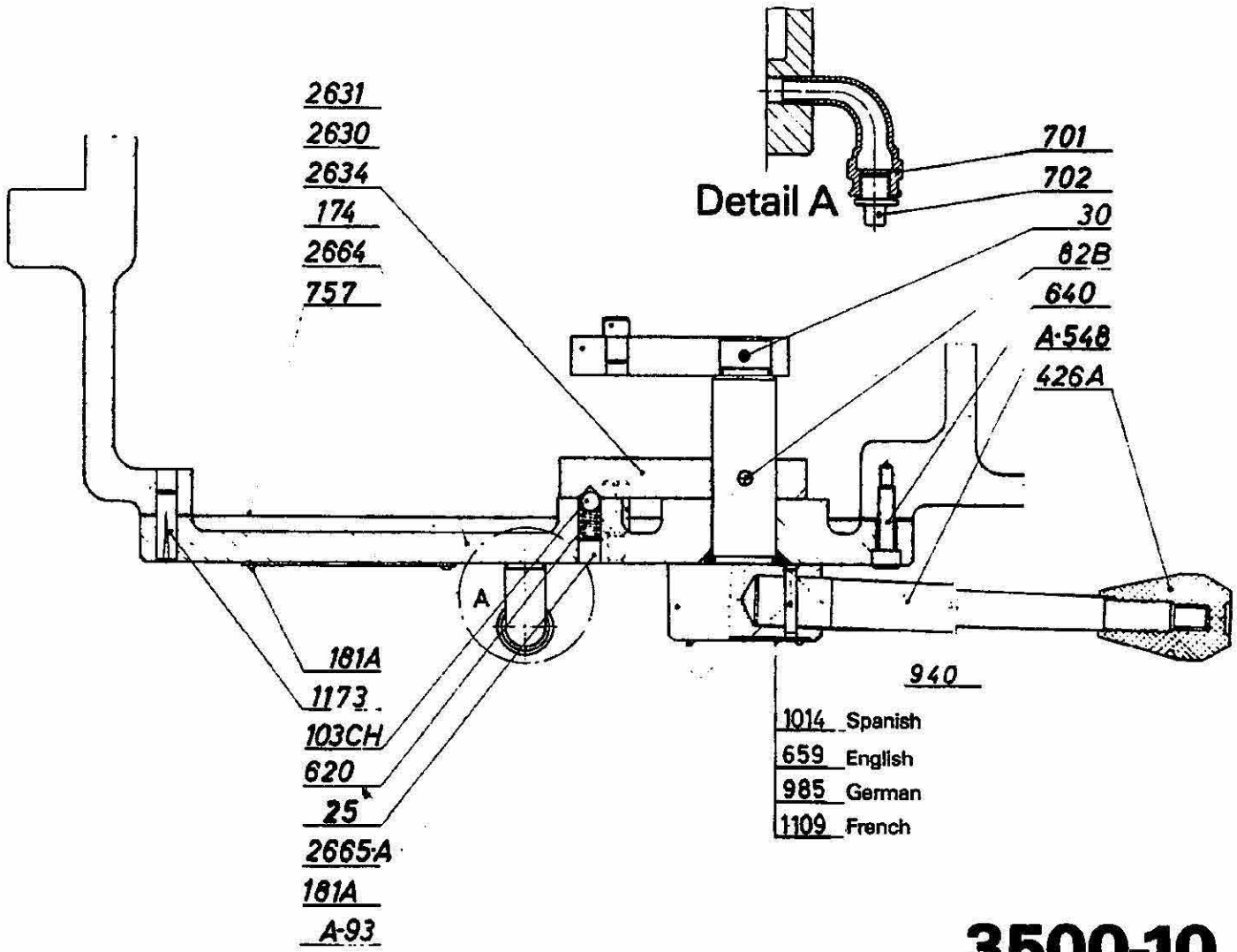

4149-6
41-A
760
640
4877-A
4878
103-D
103-C
103-CH
German 984
French 1108
English 676
Spanish 1003
42
1167
629
A-1
4887
940
2694
1358
4371
5541
586
A-93
1005
4879
426-A
152
615
3533
705
2772
2773
816
1173
615
4371

3500-8

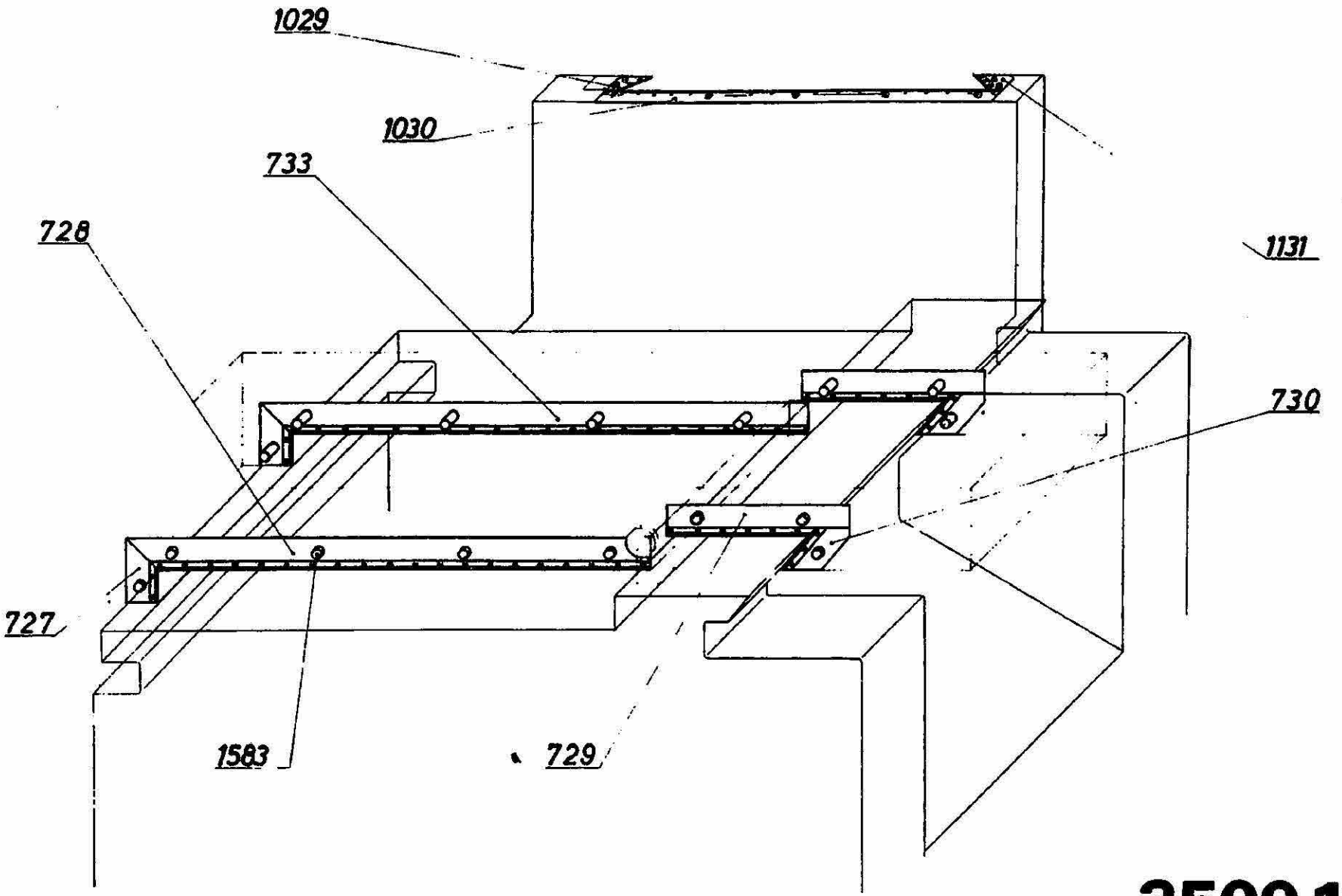


Section A-A

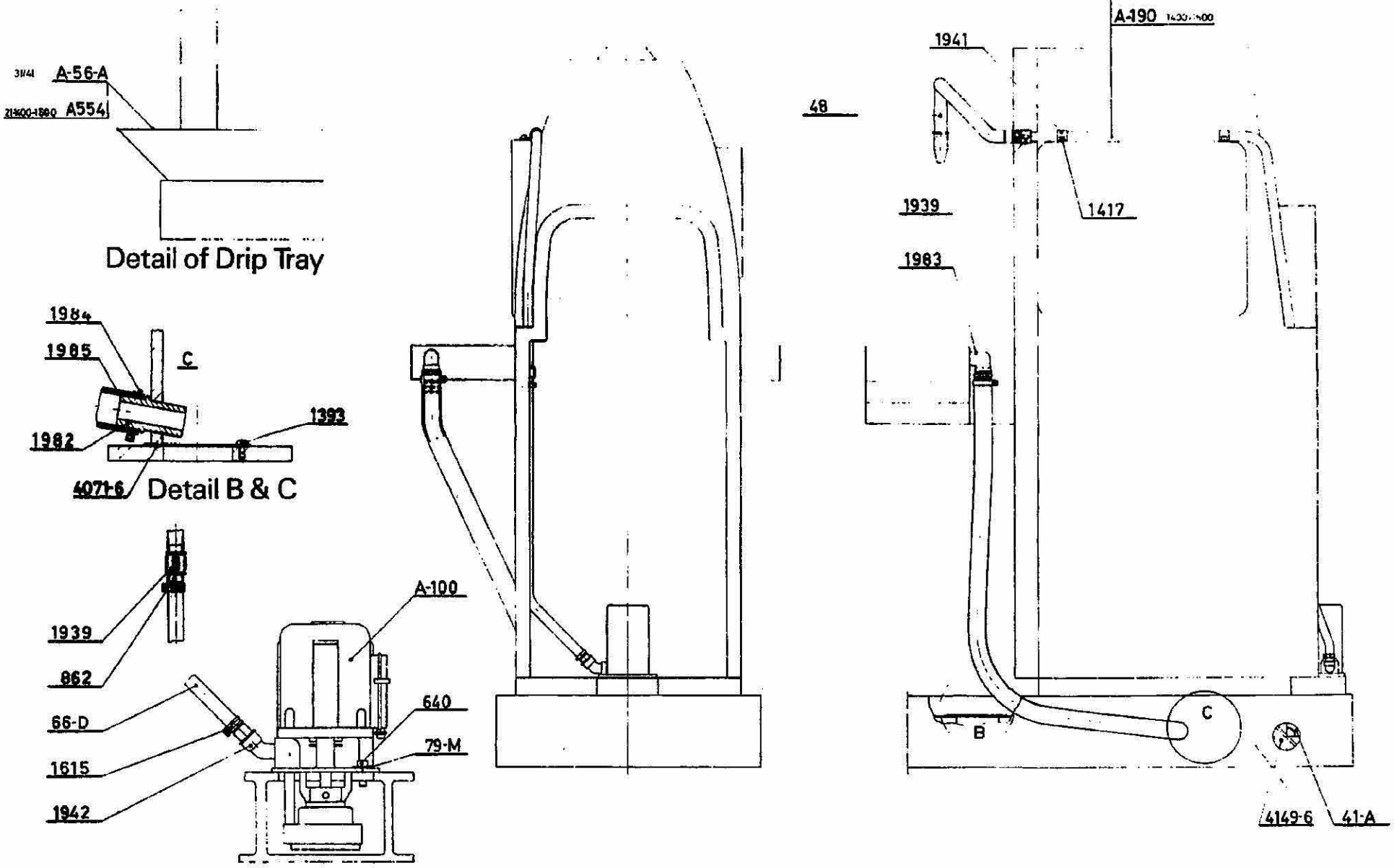
3500-9


2631
2630
2634
174
2664
757
Detail A
701
702
30
82B
640
A-548
426A
A
181A
1173
103CH
620
25
2665-A
181A
A-93
940
1014 Spanish
659 English
985 German
1109 French

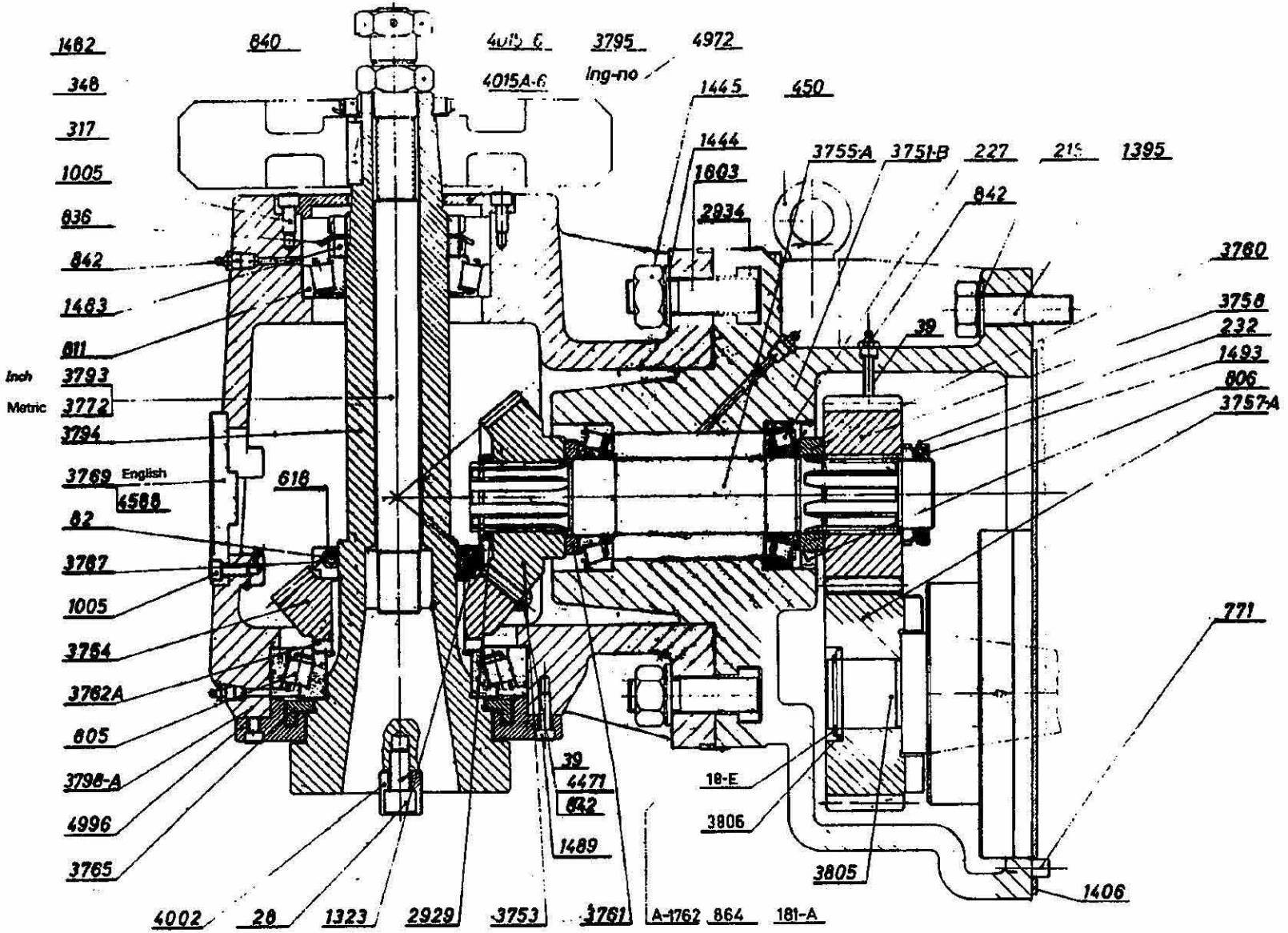
3500-10



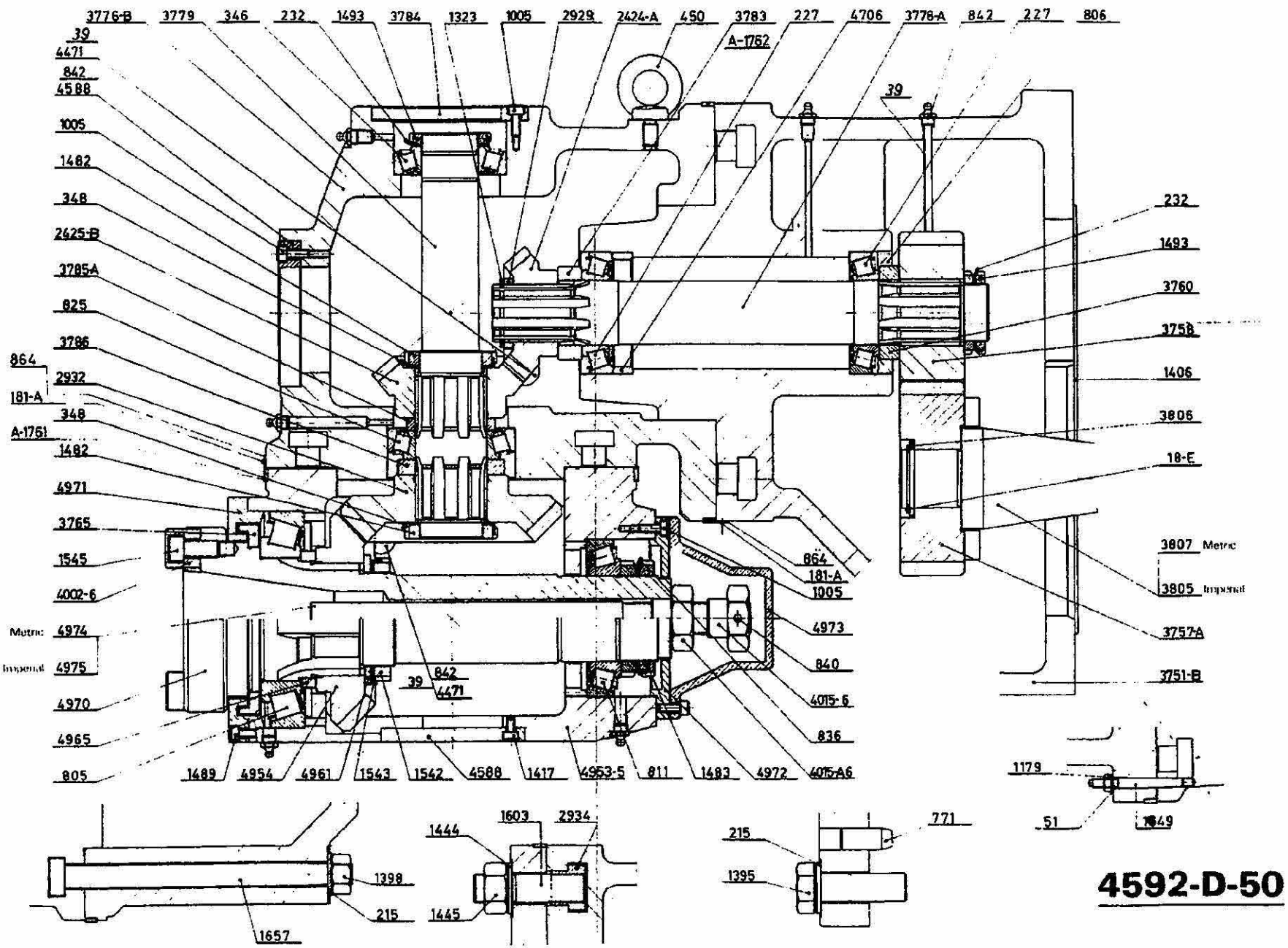
3500-11

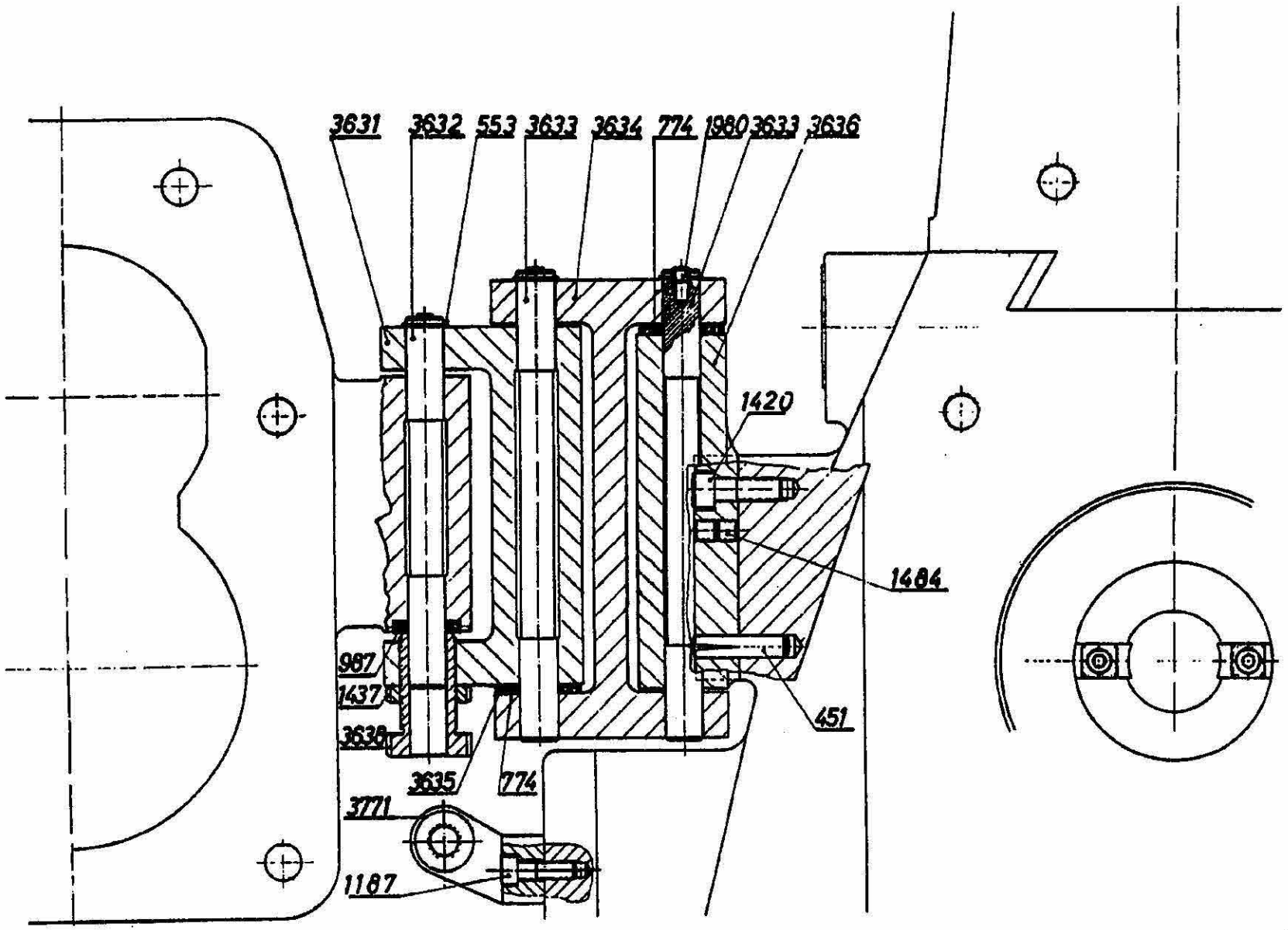

A-56-A
A554
Detail of Drip Tray
1984
1985
C
1393
1982
4071-6
Detail B & C
1939
862
66-D
1615
1942
A-100
640
79-M
48
1938
A-190
1941
1417
1939
1983
B
C
4149-6
41-A

6150

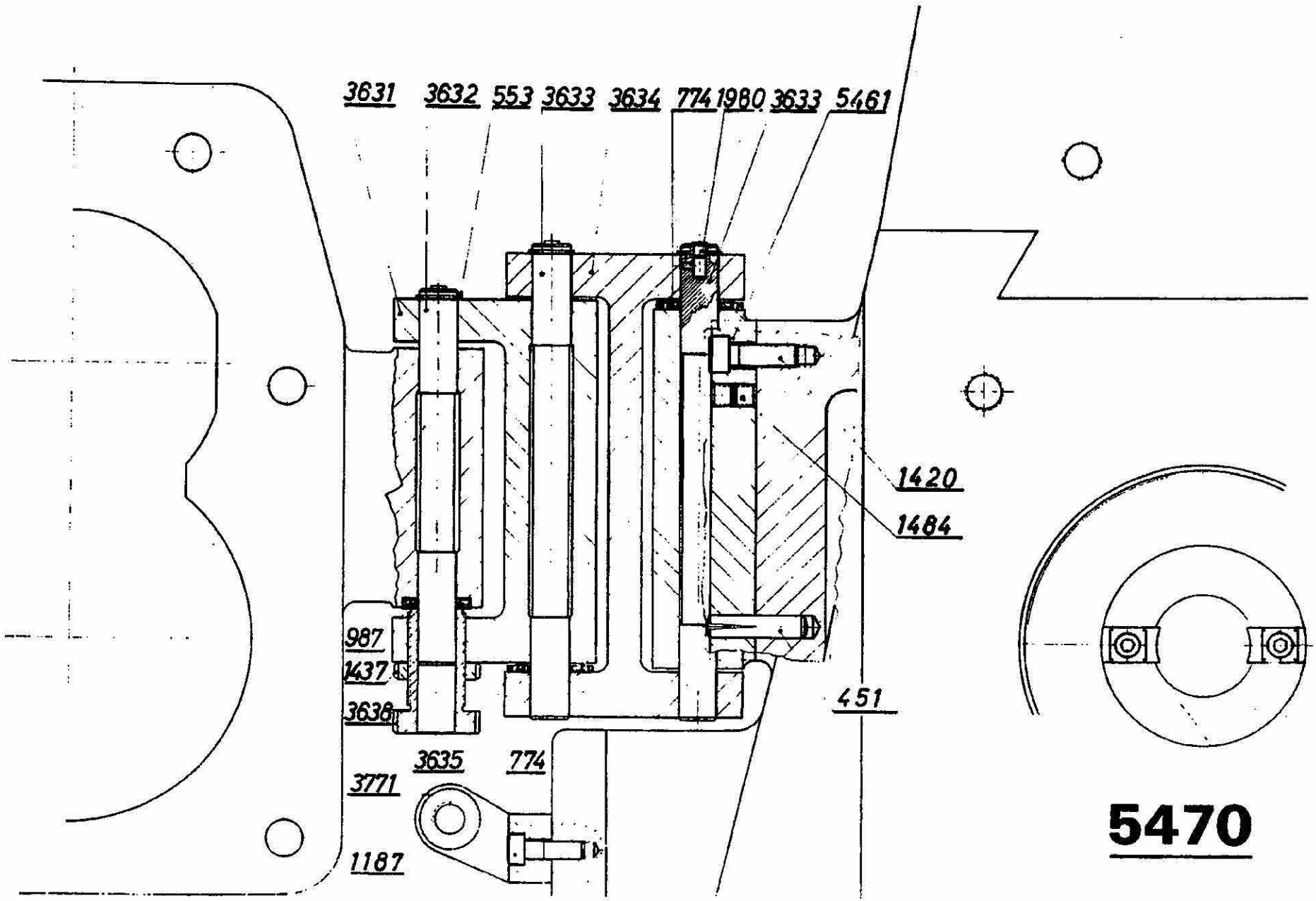

1482
840
4015-6
3795
4972
348
4015A-6
Ing-no
1445
450
317
1444
3755-A
3751-B
227
215
1395
1005
1603
842
636
2934
3760
842
3758
1463
39
232
811
1493
Inch 3793
806
Metric 3772
3757-A
3794
3769 English
618
4588
82
3767
1005
771
3764
3762A
605
39
4471
18-E
3796-A
642
3806
4996
1489
3805
3765
1406
4002
20
1323
2929
3753
3761
A-1762
864
181-A

3774-C

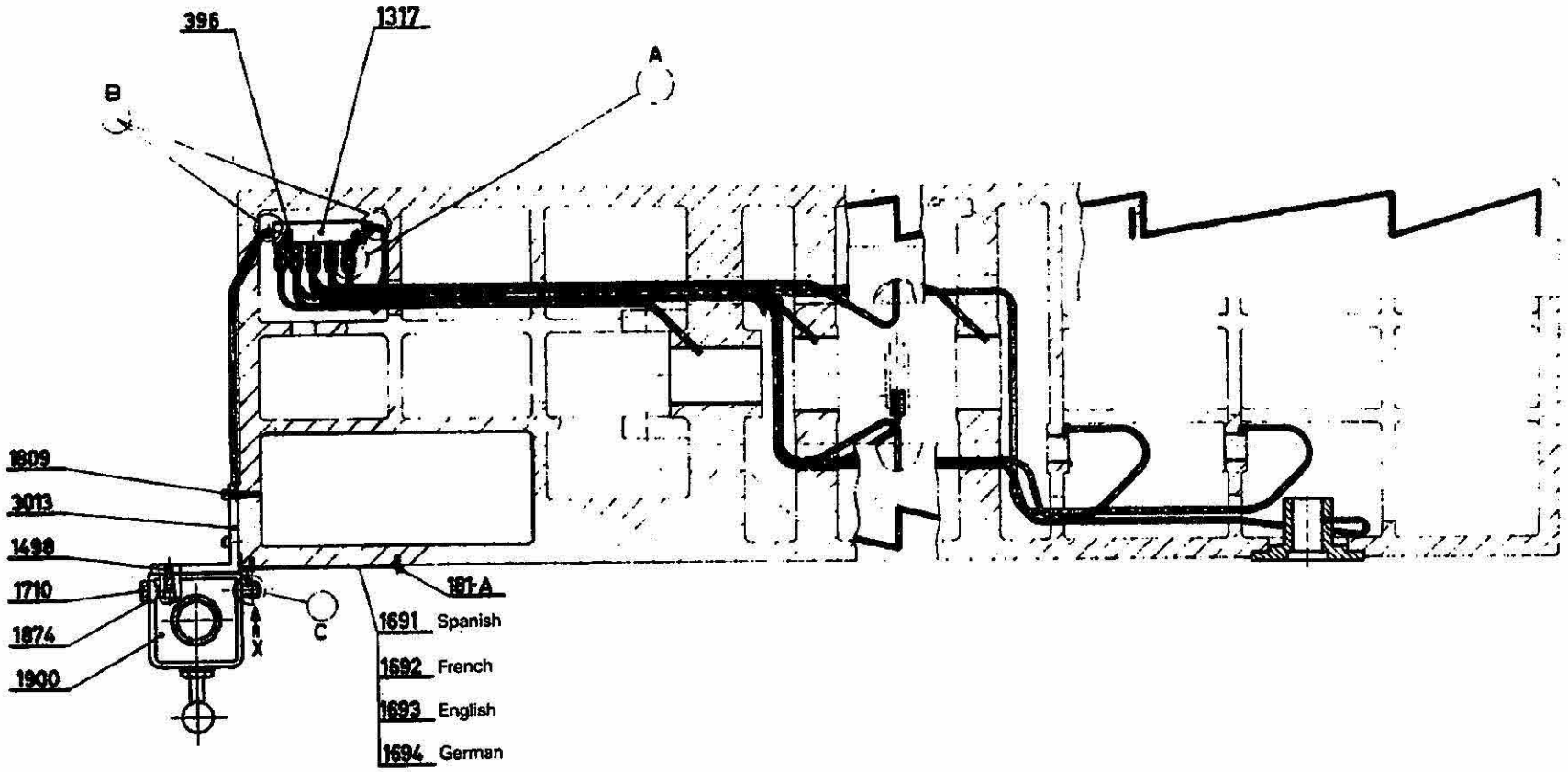

3776-B
3779
346
232
1493
3784
1323
1005
2929
2424-A
450
3783
227
4706
3778-A
842
227
806
A-1762
39
4471
842
4588
1005
1482
348
2425-B
3785-A
825
3786
864
2932
181-A
348
A-1761
1482
4971
3765
1545
4002-6
Metric 4974
Inperial 4975
4970
4965
805
1489
4954
4961
1543
1542
4588
1417
4953-5
811
1483
4972
4015-A6
836
4015-6
840
4973
1005
181-A
864
232
1493
3760
375B
1406
3806
18-E
3807 Metric
3805 Inperial
3757-A
3751-B
1179
51
1649
1398
215
1657
1444
1603
2934
1445
215
771
1395
4592-D-50

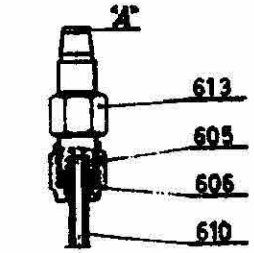

3631
3632
553
3633
3634
774
1980
3633
3636
1420
1484
987
1437
3638
3635
774
451
3771
1187

3637 (1)

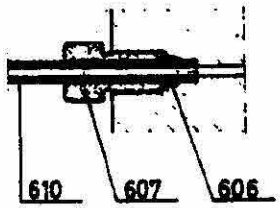

3631
3632
553
3633
3634
774
1980
3633
5461
1420
1484
987
1437
3636
451
3635
774
3771
1187

5470

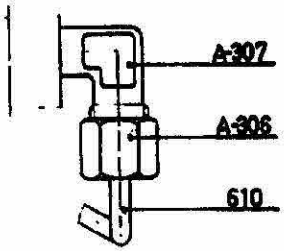




Detail A

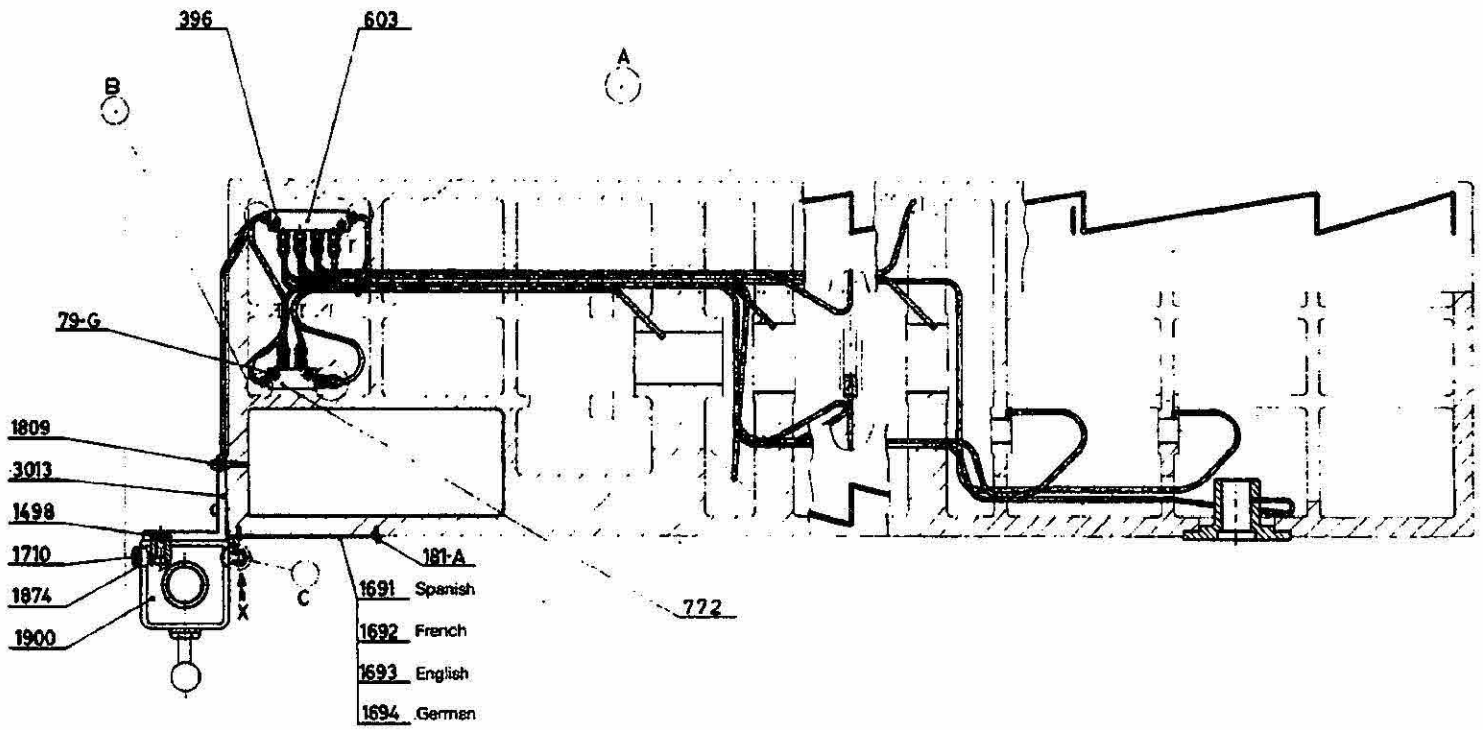


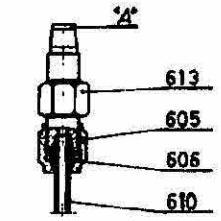
Detail B



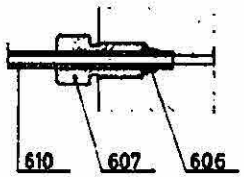
Detail C
View on X

2860

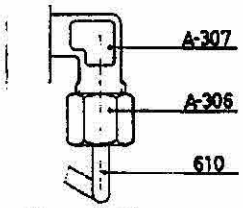




Detail A

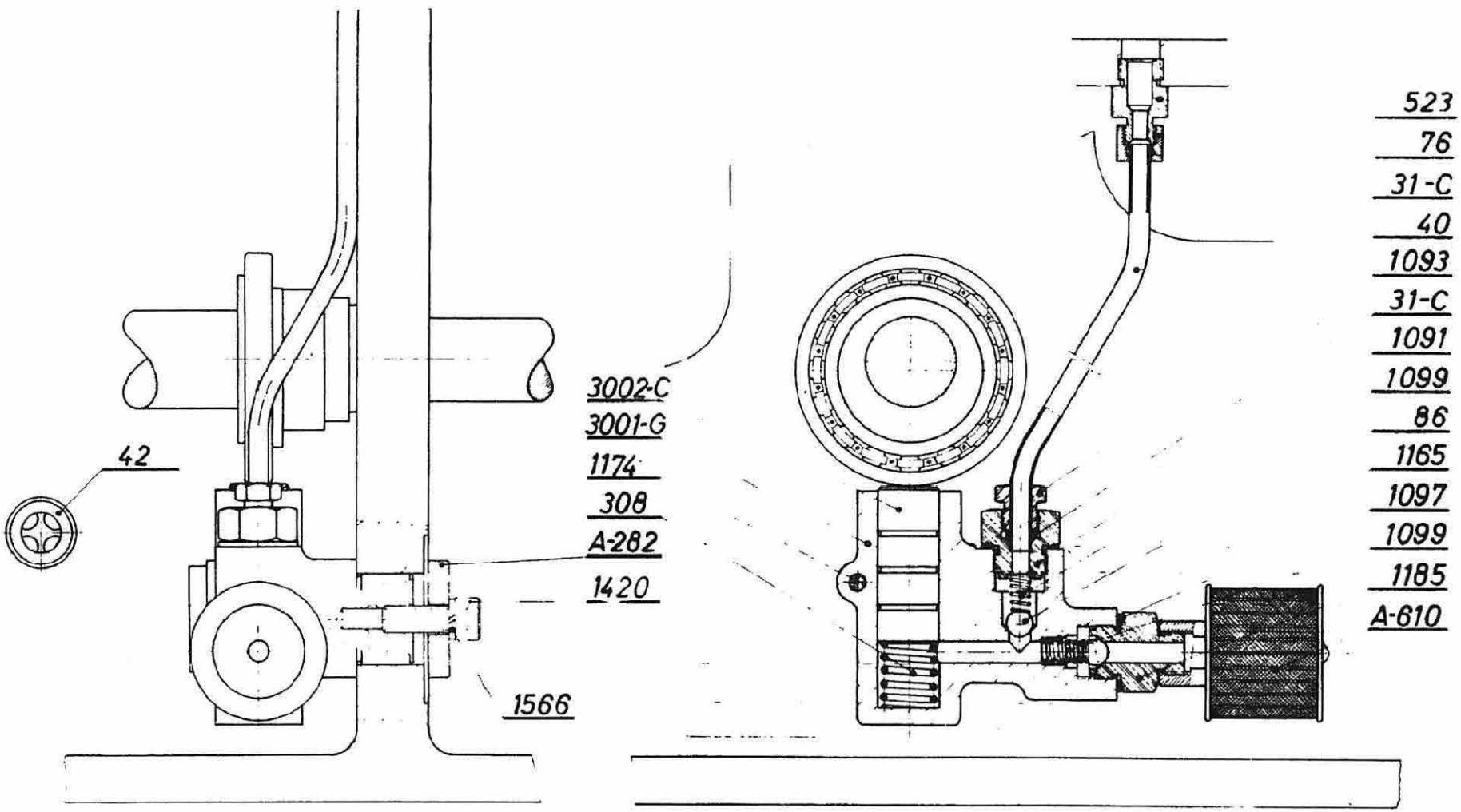


Detail B

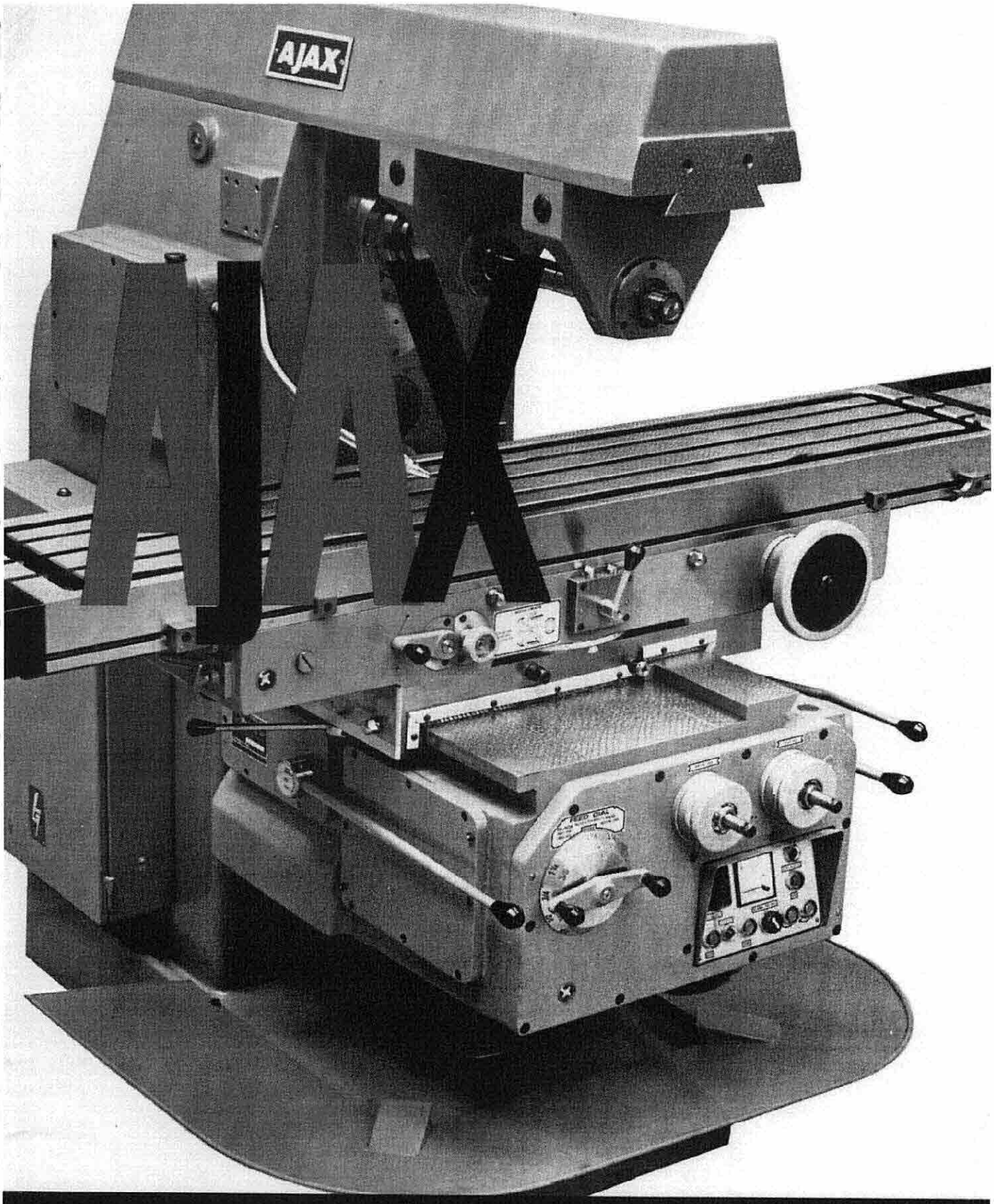


Detail C
View on X

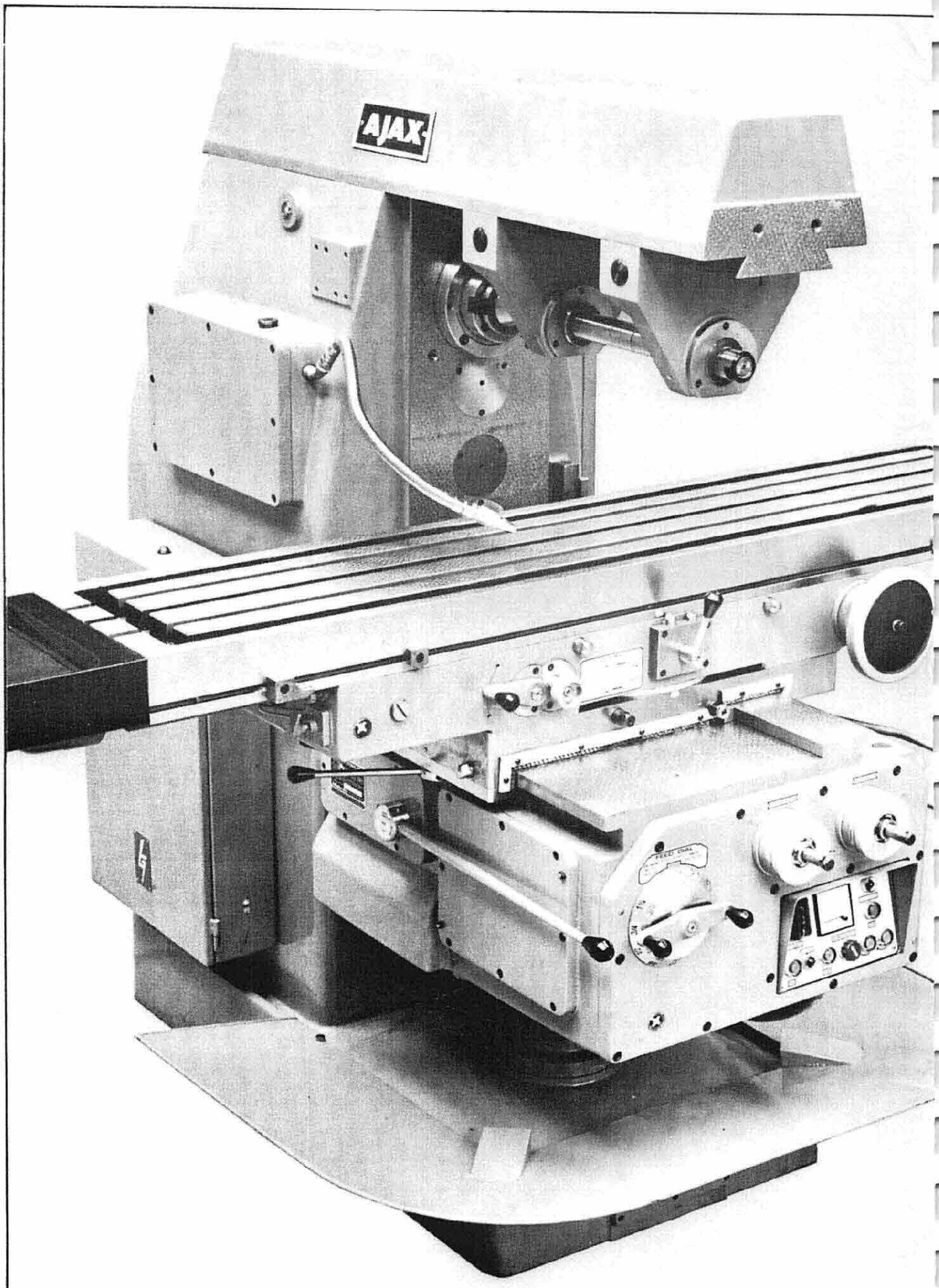
4800

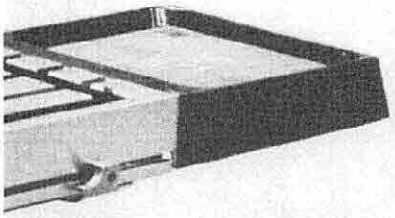

42
3002-C
3001-G
1174
308
A-282
1420
1566
523
76
31-C
40
1093
31-C
1091
1099
86
1165
1097
1099
1185
A-610

3020



AJAX MACHINE TOOL CO. LTD.
STOCKPORT ROAD · BREDBURY · CHESHIRE SK6 2AT · ENGLAND


AJAX



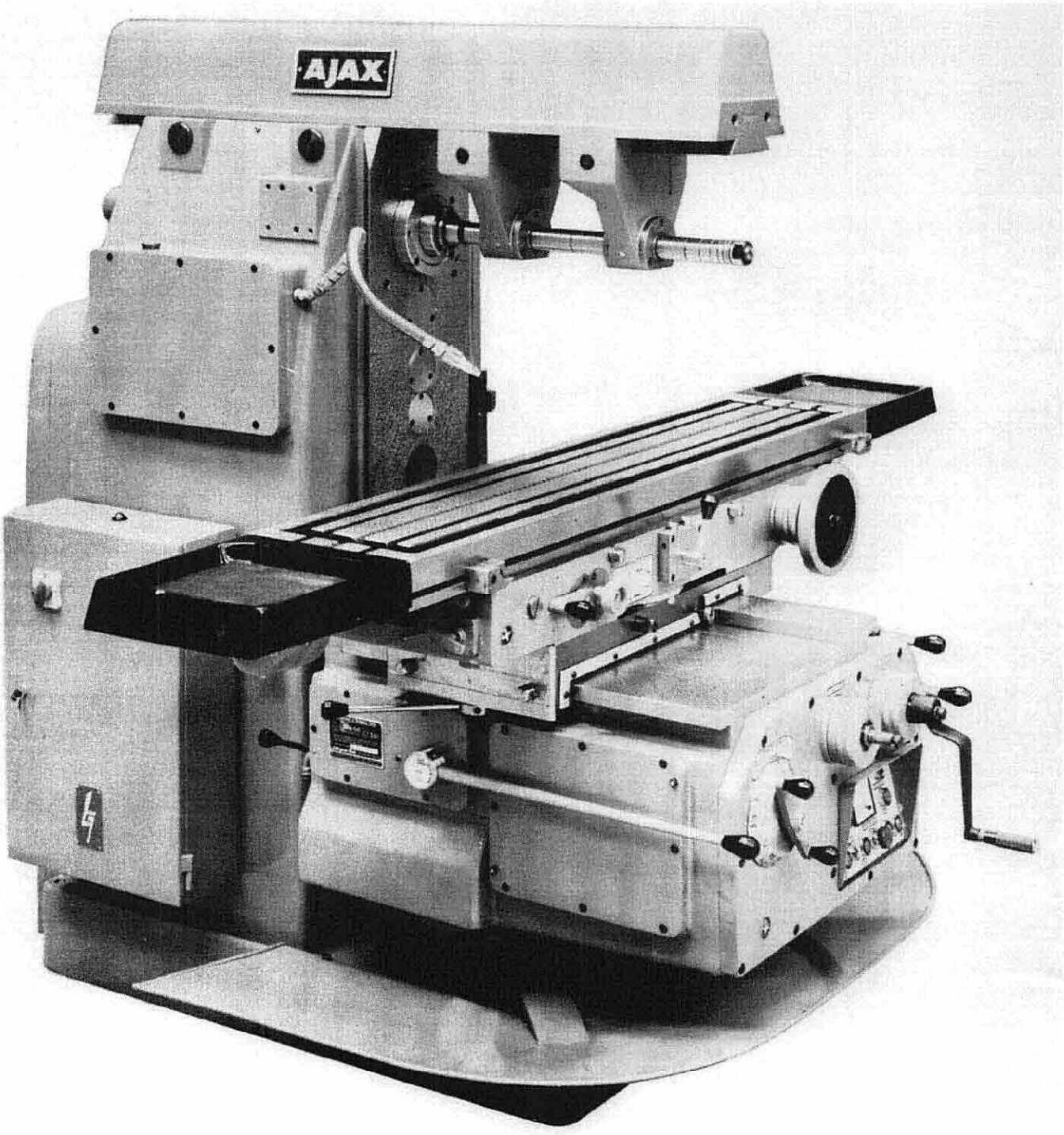
PRESENTING
THE AJAX UNIVERSAL RANGE OF MILLING MACHINES, Nos. 2, 3 & 4.

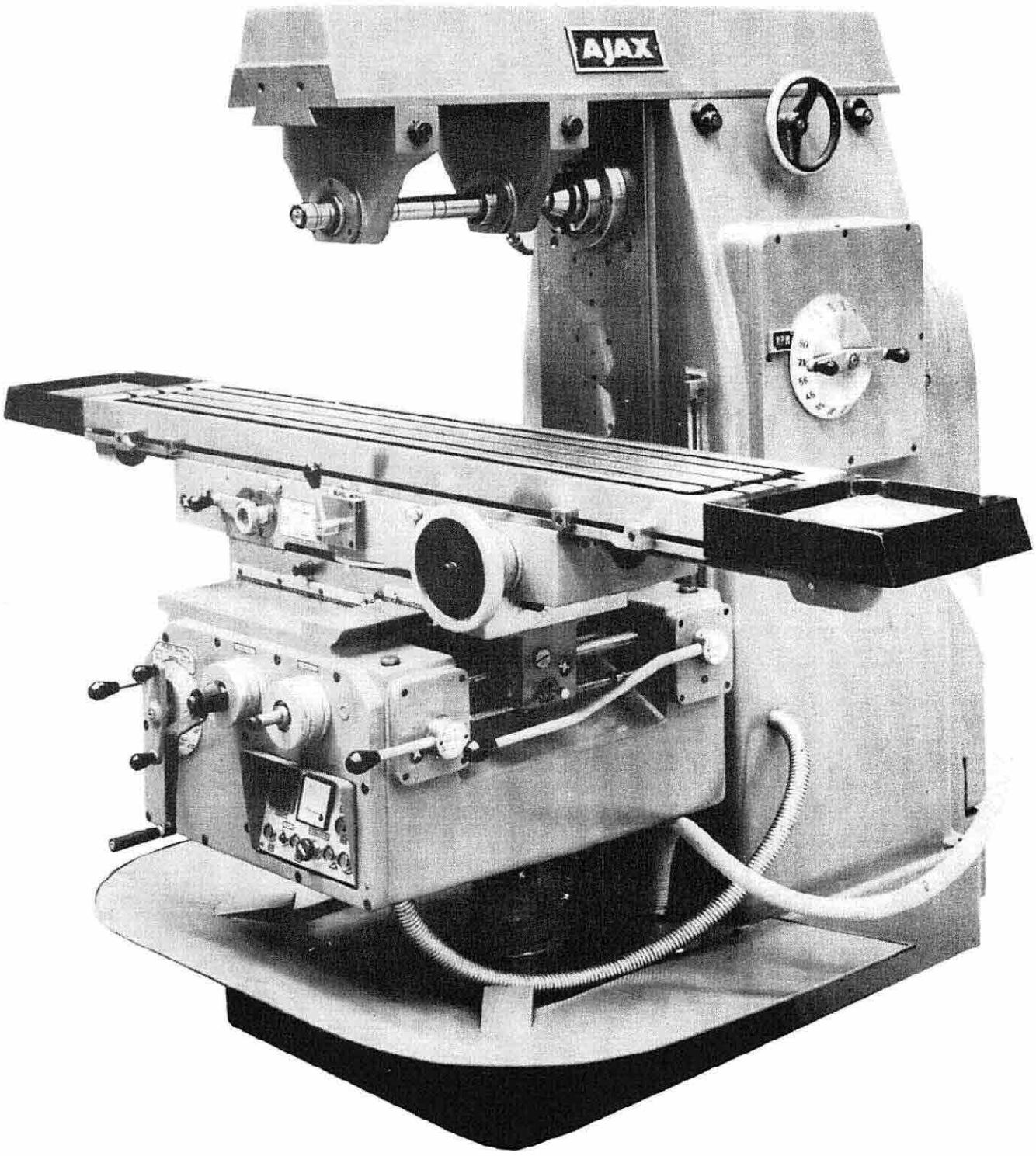
QUALITY MACHINES AT ECONOMICAL PRICES

This has been our policy since we first introduced the Ajax range of Universal Milling Machines, and it has been achieved by combining the latest design techniques with quantity production methods. The high standard of quality has been maintained, ensuring reliability in service, and accuracy of machining.

These machines can be used for toolroom or production work. The simplicity and centralisation of controls are ideal for the tool maker and the high rate of metal removal means that the machines are a "natural" for quantity production.

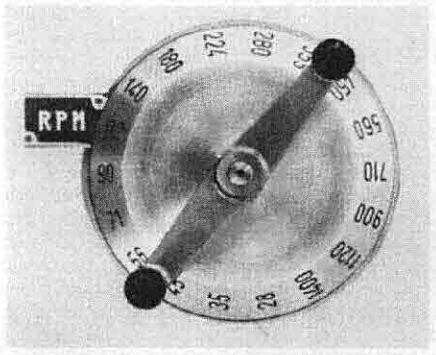
The many features of these machines, together with the range of attachments available, are detailed and illustrated in this brochure, which is your guide to the purchase of quality Milling Machines at economical prices.


AJAX

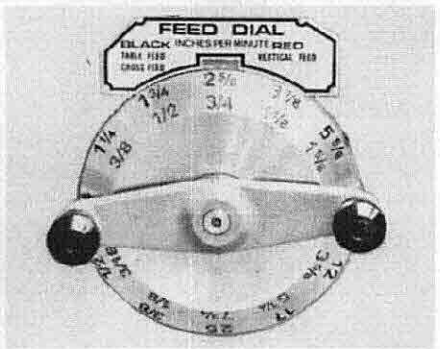

AJAX

SINGLE CRANK SELECTION OF SPEEDS & FEEDS

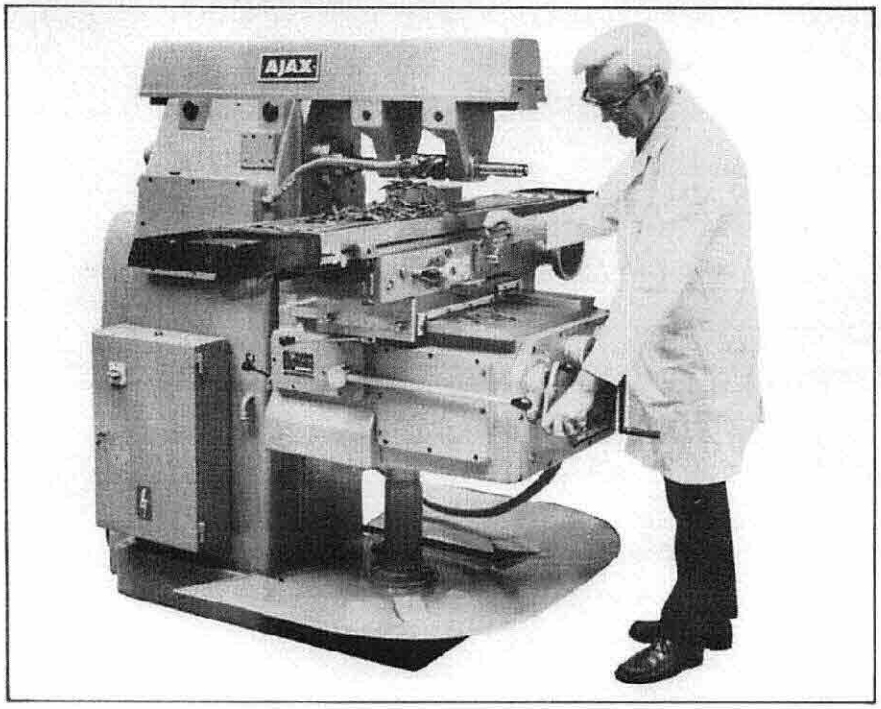
The wide range of spindle speeds, from 28 to 1400 rpm, enables milling operations to be carried out efficiently on all grades of steel, cast iron, aluminium, bronze, etc., using conventional high speed steel or carbide cutters. The appropriate speed is quickly selected. ¼ revolution of the dial per speed, or 4 speeds per revolution.



Four speeds per revolution.



Three feeds per revolution.



A high feed ratio is important in general-purpose milling machines, for the correct feed per tooth is then available for milling a wide range of different materials from hard steel to soft alloys.

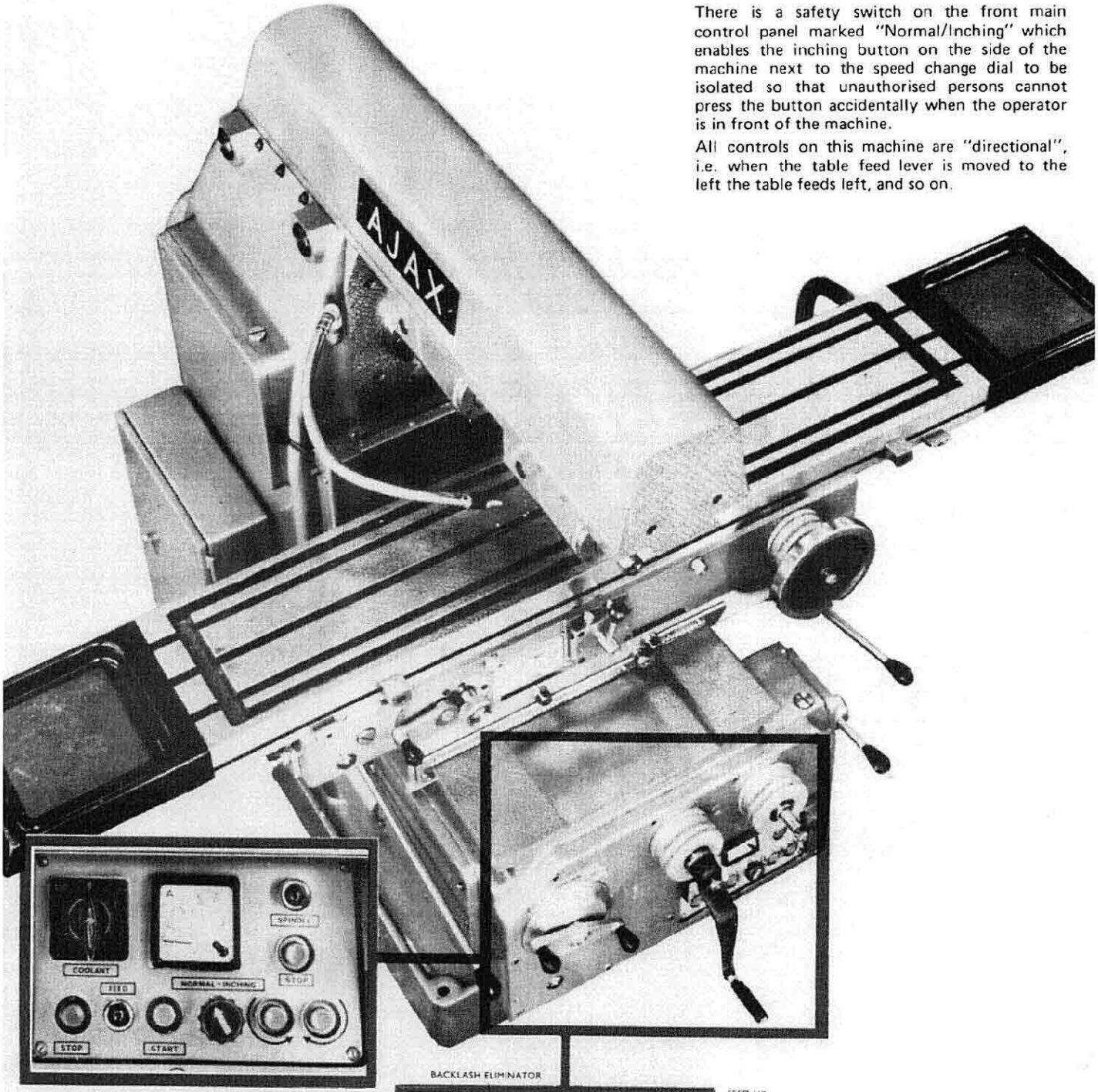
Number of feeds available 12, from ⅜" to 25½" (.375 mm to .635 mm).

CENTRALISED CONTROLS

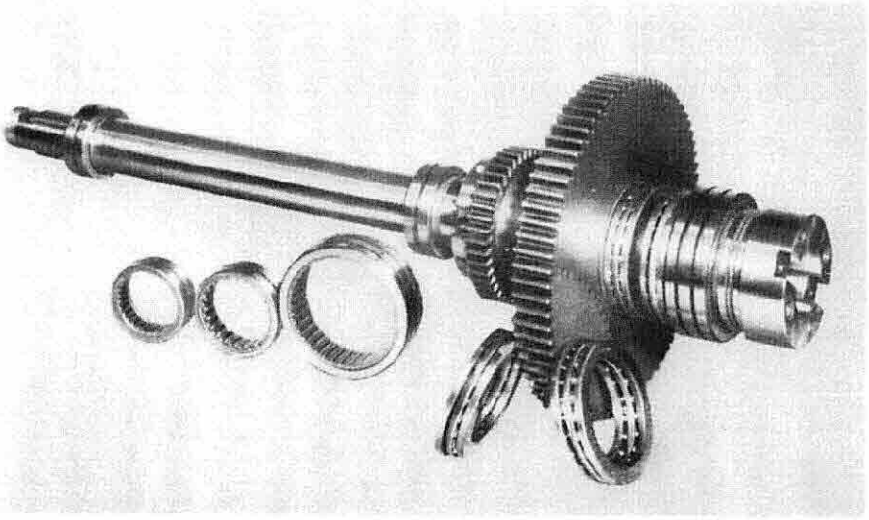
All the controls can be handled from the front of the machine, except the speed change dial, which is on the right-hand side of the machine.

There is a safety switch on the front main control panel marked "Normal/Inching" which enables the inching button on the side of the machine next to the speed change dial to be isolated so that unauthorised persons cannot press the button accidentally when the operator is in front of the machine.

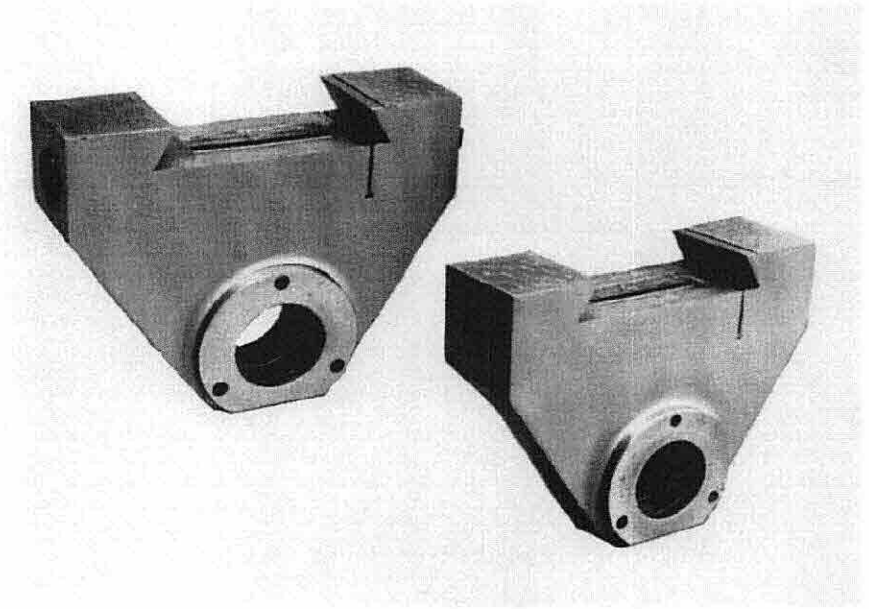
All controls on this machine are "directional", i.e. when the table feed lever is moved to the left the table feeds left, and so on.



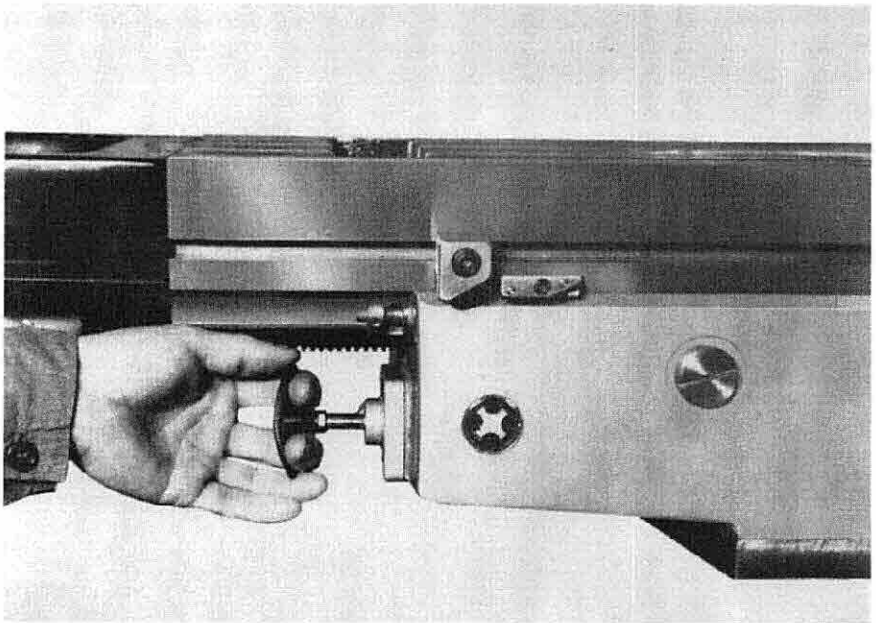
SPECIAL FEATURES AT A GLANCE



MAIN SPINDLE ASSEMBLY
The spindle is a nickel-chrome steel forging, hardened and precision ground, and mounted on needle roller and thrust bearings, which is the ideal combination for end and conventional milling.

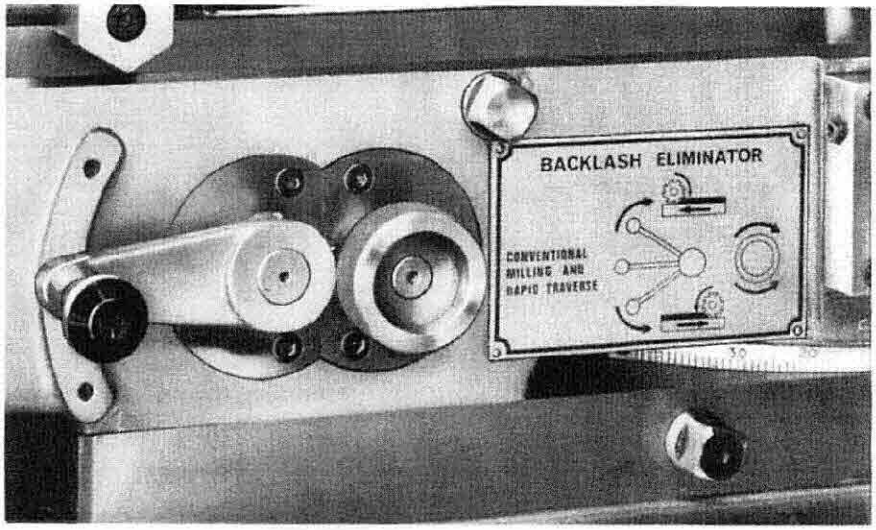


ARBOR SUPPORTS
These arbor supports are fitted with INA needle roller bearings, ensuring perfect frictionless and accurate rotation of the arbor.



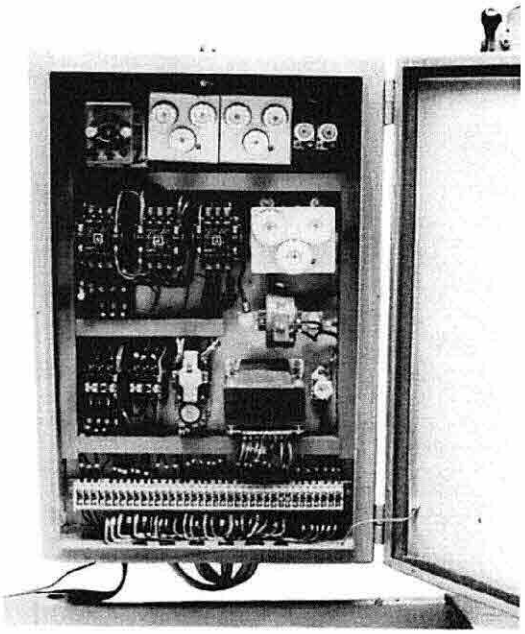
SIMPLE LUBRICATION SYSTEM
Much of the lubrication system is automatic, ensuring proper lubrication of all moving parts. Splash lubrication supplies oil to all units within the column. One shot oil system supplies lubrication to the saddle and table units.

SPECIAL FEATURES AT A GLANCE



BACKLASH ELIMINATOR

The backlash eliminator, after being pre-set, can be quickly switched "in" or "out" for the rapid traverse of the table between climb or down milling operations. Climb milling can be performed as smoothly as when taking conventional "up" milling cuts.



ELECTRICAL SYSTEM

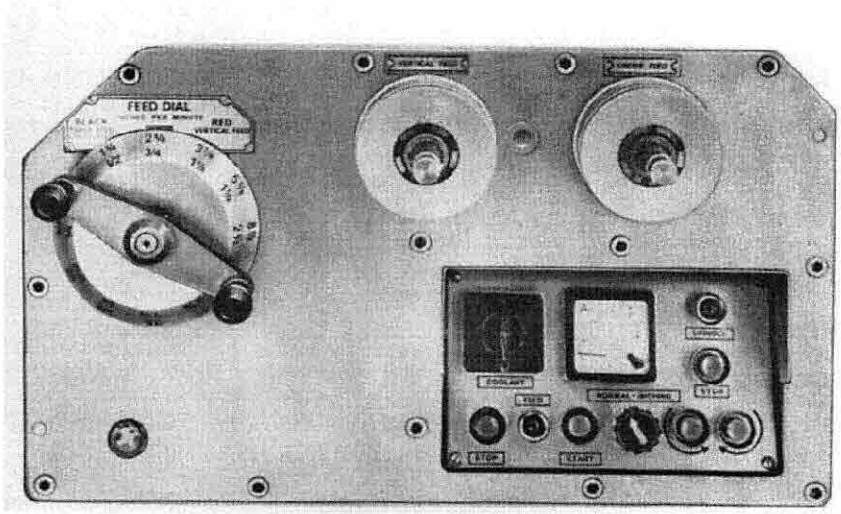
The electrical control panel is fitted with a safety isolating switch which must be in the "off" position before the control panel door can be opened. Top quality contactors and relays are used throughout manufacture by companies of international reputation, replacements for which are readily available all over the world. All control circuits are operated through a low voltage transformer (48 volts) to comply with best safety conditions.

English and Continental markets

Quick change cartridge fuses are used throughout.

American market

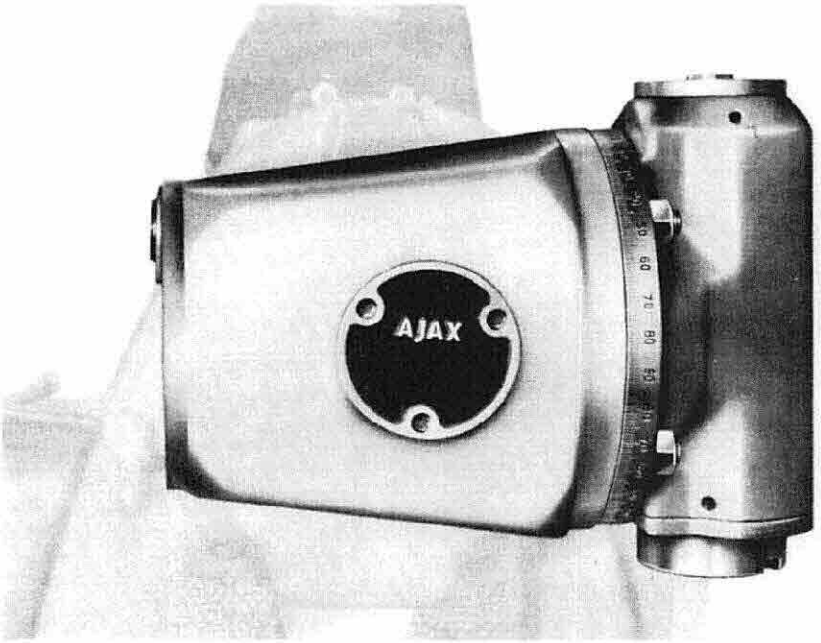
Standard Bridge type fuses are used throughout, replacements for which are readily available in the USA.



ELECTRICAL CONTROLS

The electrical panel is within easy reach of the operator's right hand for fingertip control. A special safety device is incorporated for isolating the inching button adjacent to the spindle dial speed change on the side of the machine.

ACCESSORIES



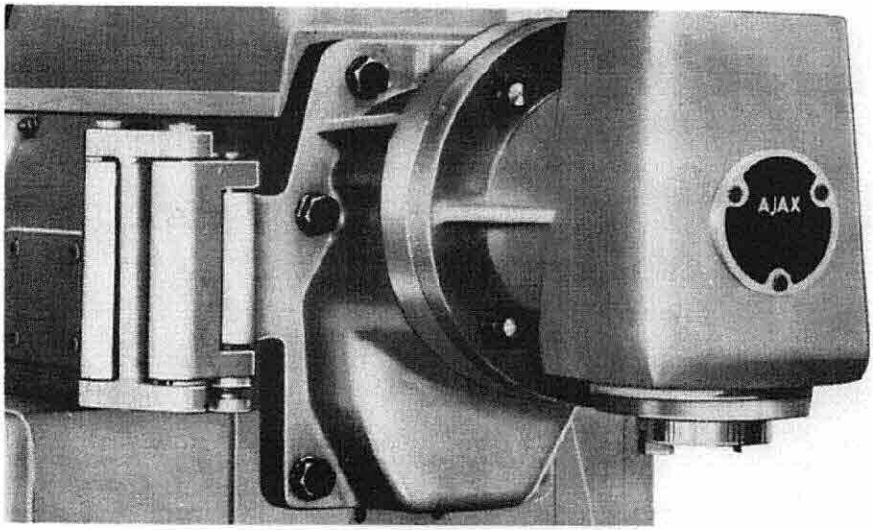
UNIVERSAL MILLING HEAD

Swivels 360° in two planes.

Fitted with Klingenberg spiral bevel gears.

Spindle taper size for No. 2, No. 3 and No. 4 machine ISO 40.

This Head is fitted with a hinged bracket to enable it to be swung aside when not in use.



VERTICAL HEAD

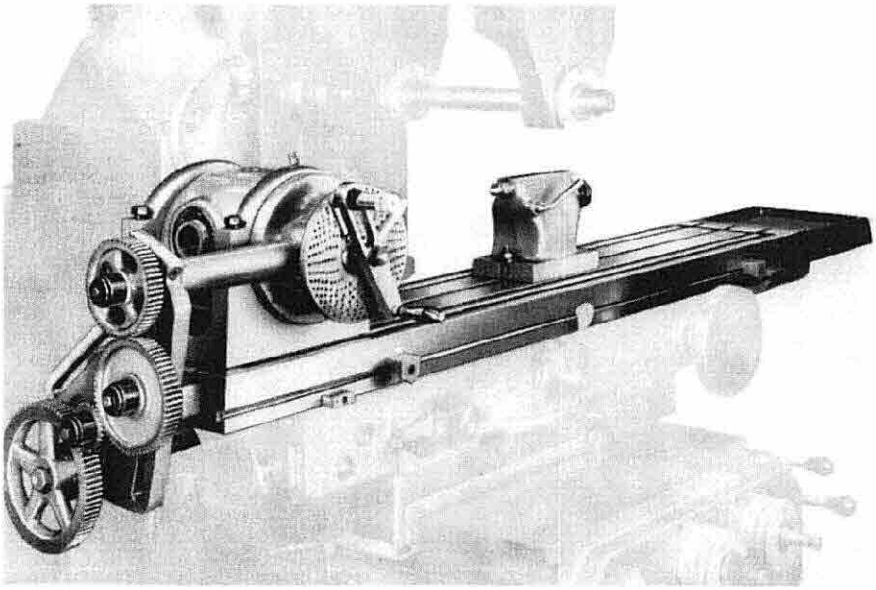
Swivels 360° in one plane.

Fitted with Klingenberg spiral bevel gears.

Spindle taper size for No. 2 machine ISO 40: No. 3 and No. 4 machine ISO 50.

This Head has been specially designed for heavy-duty cutting operations.

This Head is fitted with a hinged bracket to enable it to be swung aside when not in use.



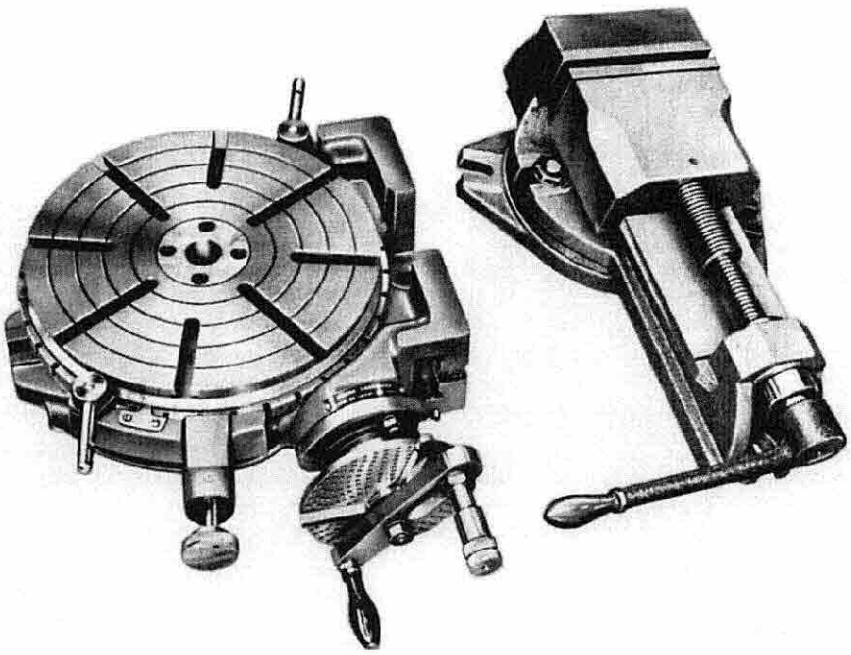
UNIVERSAL DIVIDING HEAD

The Dividing Head has direct indexing without worm and wormwheel or indirect indexing with worm and wormwheel.

Centre height, No. 2 machine 5¾" (150 mm): No. 3 and No. 4 machine 6¾" (175 mm).

A Hobbing and Spiral milling attachment is available on request.

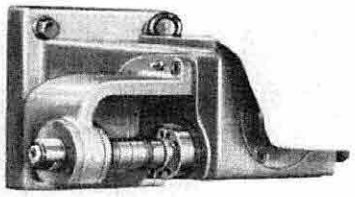
ACCESSORIES



ROTARY TABLES AND UNIVERSAL MACHINE VICES

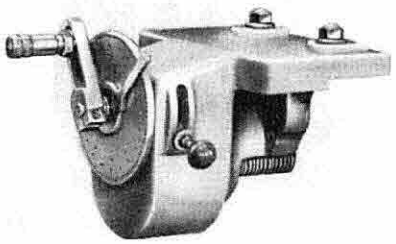
Rotary tables are available in four sizes: 10", 12", 14" and 16" diameter (250, 305, 355 and 406 mm). These are highly accurate milling tables manufactured to specified limits, the worm-wheel being made from hard chrome-nickel steel, hardened and ground. These tables can be mounted in a horizontal or vertical position.

The Vices are available in three sizes, width of jaws being 4½", 6" and 8" (114, 152 and 203 mm).



RACK CUTTING ATTACHMENT

Rack Cutting Attachment is convenient for milling long racks or accurately spaced slots.

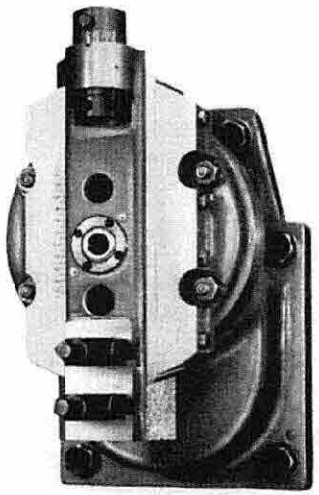


OPTICAL MEASURING EQUIPMENT

Optical measuring equipment is available for the longitudinal and cross traverses on all machines but can only be fitted prior to despatch from the factory.

SLOTTING ATTACHMENT

The Head can be set at any angle by means of a graduated scale at the side of the Head. Maximum stroke 3⅛" (100 mm) which can be adjusted according to requirements.



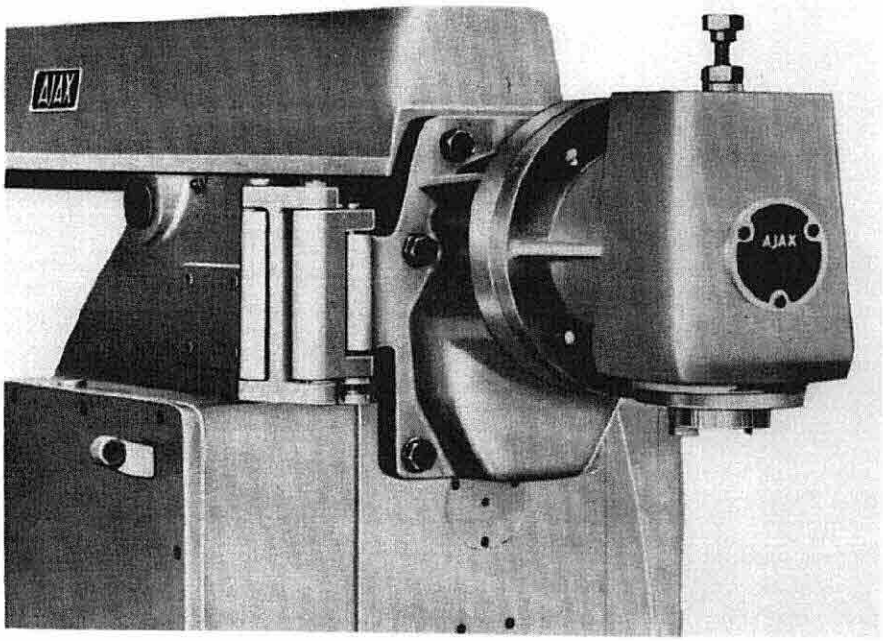
DIGITAL READOUT EQUIPMENT

Heidenhain Digital Readout equipment is available for the longitudinal and cross traverse on all machines but can only be fitted prior to despatch from the factory.

A selector switch enables English or metric measurement to be used. A zero setting button allows either axis to be re-set to zero at any point along the axis.

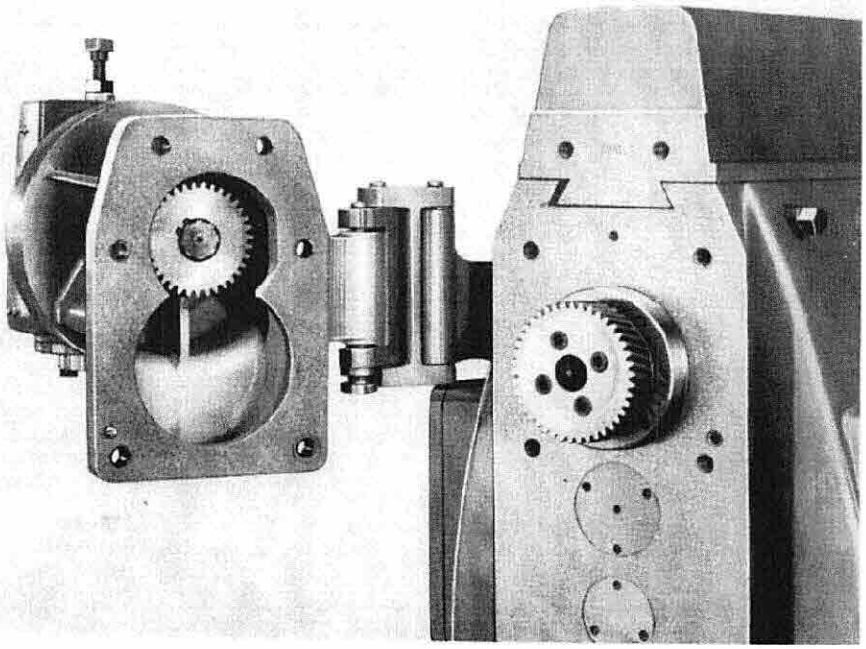
Pre-set feature—distance required to travel per axis can be pre-set and machine traversed to zero point for ease of reading and operation.

FITTING OF VERTICAL AND UNIVERSAL HEADS



Vertical Head with hinged attachment locked in operating position.

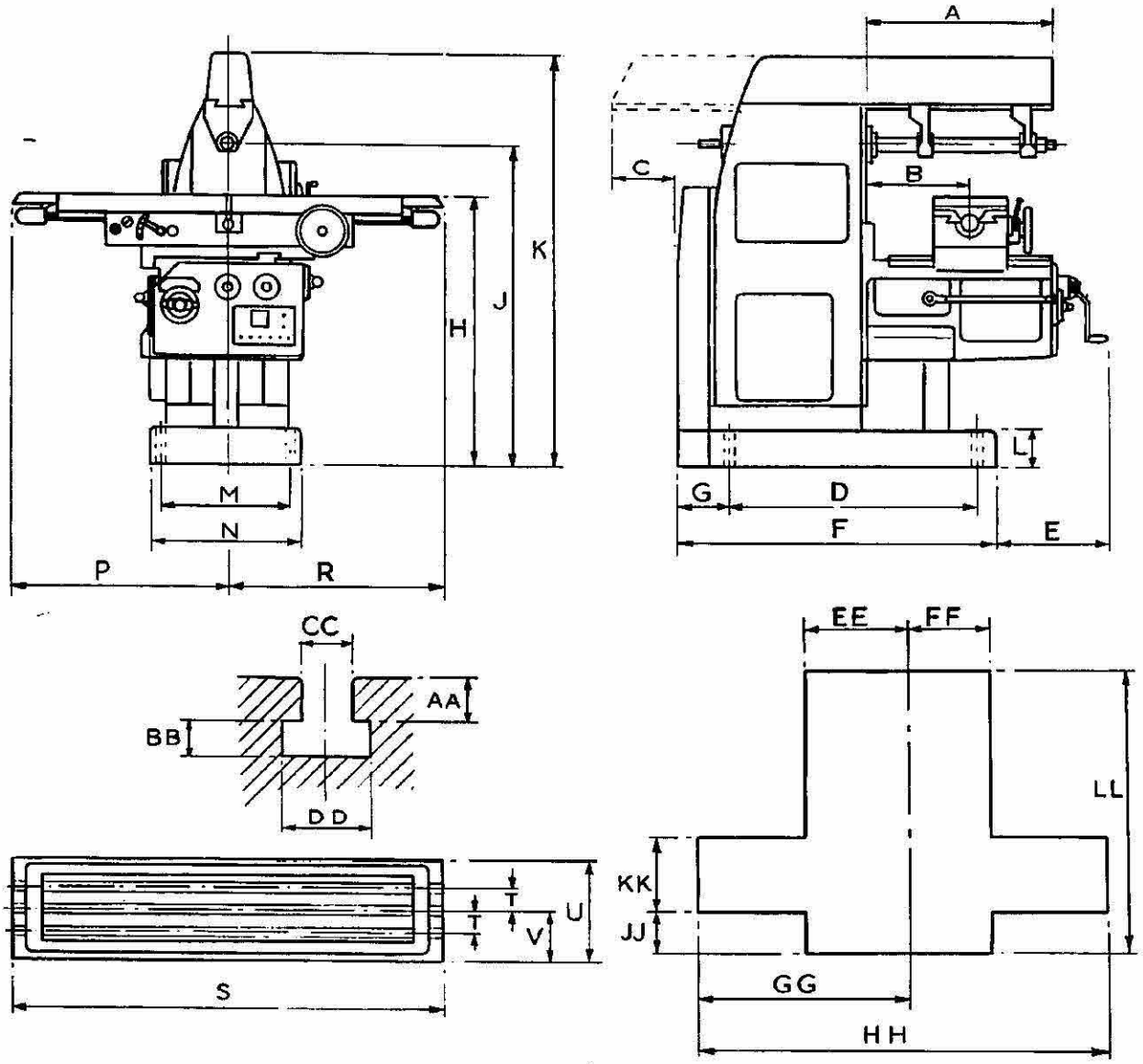
This machine can be supplied complete with Universal or Vertical Heads with Special Hinged Attachment to enable the Head to be swung back when carrying out conventional milling. This obviates the work involved in removing and re-assembling the Head to the machine with the consequent lifting problems when conventional milling is carried out. When ordering your machine you should specify whether you require a Vertical or Universal Head to be fitted.



Head shown clear of spindle nose prior to change-over to horizontal milling.

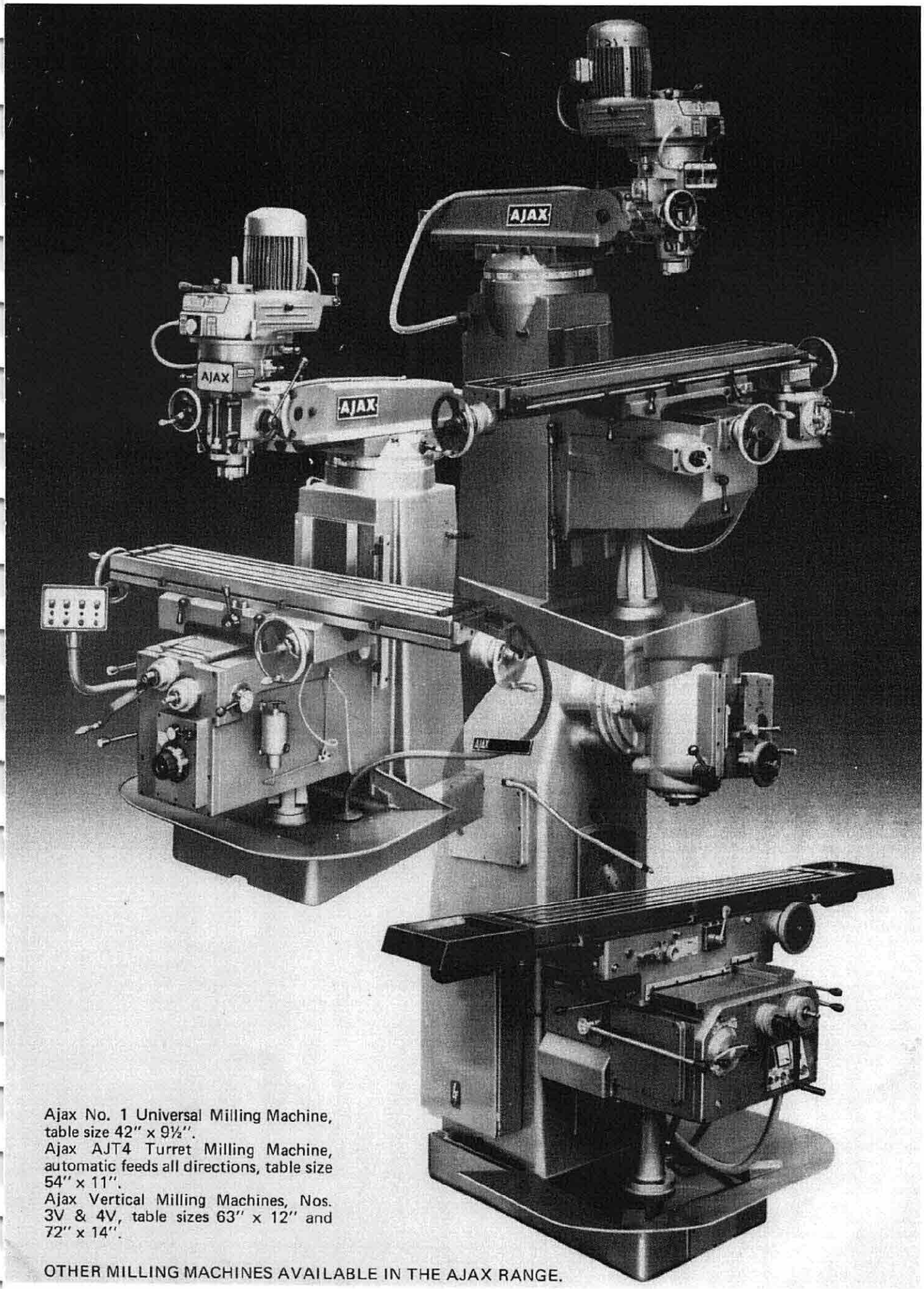
SPECIFICATION

	No. 2 Ajax Universal Milling Machine		No. 3 Ajax Universal Milling Machine		No. 4 Ajax Universal Milling Machine	
TABLE						
Working surface	55″ × 11″	1400 × 280 mm	63″ × 12″	1600 × 305 mm	72″ × 14″	1830 × 355 mm
T-slots, number and size	3 × $\frac{5}{8}$″	3 × 16 mm	3 × $\frac{5}{8}$″	3 × 16 mm	3 × $\frac{11}{16}$″	3 × 18 mm
T-slots centres	2$\frac{13}{16}$″	56 mm	2$\frac{1}{2}$″	63 mm	2$\frac{1}{2}$″	65 mm
Swivel movement	90° inclusive		90° inclusive		90° inclusive	
RANGE OF TABLE						
Longitudinal	42″	1067 mm	47$\frac{1}{2}$″	1206 mm	53″	1345 mm
Cross	11″	280 mm	12″	305 mm	12″	305 mm
Vertical	16$\frac{1}{2}$″	420 mm	19″	483 mm	18″	455 mm
Maximum distance from centre of spindle to table	16$\frac{1}{2}$″	420 mm	19″	483 mm	18″	455 mm
SPINDLE						
Taper ISO	No. 40	No. 40	No. 50	No. 50	No. 50	No. 50
Arbor diameter	1″	25,4	1$\frac{1}{4}$″	32 mm	1$\frac{1}{4}$″	32 mm
Number of speeds	18	18	18	18	18	18
Speed range	28–1400 rpm		28–1400 rpm		28–1400 rpm	
FEEDS						
Number of feeds	12		12		12	
Longitudinal	$\frac{3}{8}$″–25″/min.	9,5–635 mm/min.	$\frac{3}{8}$″–25″/min.	10–635 mm/min.	$\frac{3}{8}$″–25″/min.	10–650 mm/min.
Cross	$\frac{3}{8}$″–25″/min.	9,5–635 mm/min.	$\frac{3}{8}$″–25″/min.	10–635 mm/min.	$\frac{3}{8}$″–25″/min.	10–650 mm/min.
Vertical	$\frac{1}{8}$″–7$\frac{3}{4}$″/min.	3,0–197 mm/min.	$\frac{1}{8}$″–7$\frac{3}{4}$″/min.	3–197 mm/min.	$\frac{1}{8}$″–7$\frac{3}{4}$″/min.	3–195 mm/min.
RAPID TRAVERSE						
Longitudinal	118″/min.	3000 mm/min.	118″/min.	3000 mm/min.	118″/min.	3000 mm/min.
Cross	118″/min.	3000 mm/min.	118″/min.	3000 mm/min.	118″/min.	3000 mm/min.
Vertical	39″/min.	1000 mm/min.	39″/min.	1000 mm/min.	35$\frac{1}{2}$″/min.	900 mm/min.
MOTORS						
Spindle Drive Motor	6 H.P.		10 H.P.		12$\frac{1}{2}$ H.P.	
Feed Drive Motor	1$\frac{1}{2}$ H.P.		2 H.P.		2$\frac{1}{2}$ H.P.	
Coolant Motor	$\frac{1}{8}$ H.P.		$\frac{1}{8}$ H.P.		$\frac{1}{8}$ H.P.	
WEIGHT						
Nett weight approximately	4,650 lbs.	2150 Kg.	6,380 lbs.	2900 Kg.	8,910 lbs.	4050 Kg.
Gross weight approximately	5,500 lbs.	2500 Kg.	6,820 lbs.	3100 Kg.	10,230 lbs.	4650 Kg.
Shipping case size (length × height × width)	78″ × 72″ × 78″	1·98 m. × 1·9 m. × 1·98 m.	73″ × 77″ × 71″	2·13 m. × 1·98 m. × 2·13 m.		
Volume	254 cu.ft	7·5 cu.m.	231 cu.ft.	9 cu.m.		



		A	B		C	D	E	F	G	H		J	K	L	M	N	P	
			Min	Max						Min	Max						Min	Max
No. 2	Inches	29¼	9 3/16	20 3/16	19	40⅜	21½	47⅜	6 3/16	36	52½	52½	66½	6	21	23½	21¾	64½
	m.m.	742	233	510	482	1025	546	1210	157	908	1326	1332	1689	152	533	597	552	1627
No. 3	Inches	28¾	8⅜	20⅜	20½	45¾	18½	54½	7 7/16	37¾	56¾	56¾	70¾	7	24⅜	27	22¼	69¼
	m.m.	730	214	518	520	1162	470	1384	189	959	1440	1440	1797	178	619	686	565	1759
No. 4	Inches	29½	9⅛	21½	23	45¾	18⅞	54½	7¼	39¼	58¼	58¼	73½	8	24⅜	27	26⅜	79⅜
	m.m.	750	232	546	584	1162	480	1384	184	997	1479	1480	1867	203	619	686	670	2022

		R		S	T	U	V	AA	BB	CC	DD	EE	FF	GG	HH	JJ	KK	LL
		Min	Max															
No. 2	Inches	21	60½	55⅛	3	11	5½	9/16	15/32	⅝	1 3/32	15	11	64½	125	12¼	22	69⅛
	m.m.	533	1537	1400	76	280	140	14	12	16	28	381	280	1638	3175	311	558	1755
No. 3	Inches	21	68¼	63	2½	12	6	9/16	15/32	⅝	1 3/32	17½	13½	69¼	137½	13½	24	73
	m.m.	533	1734	1600	63	304	152	14	12	16	28	445	330	1759	3493	260	620	1854
No. 4	Inches	23¾	77	70¾	2¾	13 13/16	6 29/32	45/64	9/16	45/64	1¼	19	16½	79⅜	156⅜	12	26	73⅜
	m.m.	603	1956	1800	70	350	175	18	14	18	32	483	419	2022	3978	305	660	1864



Ajax No. 1 Universal Milling Machine, table size 42" x 9½".
Ajax AJT4 Turret Milling Machine, automatic feeds all directions, table size 54" x 11".
Ajax Vertical Milling Machines, Nos. 3V & 4V, table sizes 63" x 12" and 72" x 14".

OTHER MILLING MACHINES AVAILABLE IN THE AJAX RANGE.

RANDO® HDZ

15, 22, 32, 46, 68, 100

PRODUCT DESCRIPTION

Rando® HDZ oils are formulated with premium base oil technology and designed to give robust protection to hydraulic pumps.

CUSTOMER BENEFITS

Rando HDZ oils deliver value through:

- **High oxidation stability** — Long service life in high pressure service.
- **Protection against rust and corrosion** — Gives excellent protection against corrosion of both copper and steel. Passes the ASTM D665A distilled water rust test and ASTM D665B salt water rust test.
- **High viscosity index** — Minimum change in viscosity over a wide range of operating temperatures.
- **Foam inhibition** — Contains special foam suppressant.
- **Excellent antiwear properties** — Provides excellent wear protection.
- **Good stability** — in the presence of water in the ASTM D2619 Hydrolytic Stability Test and in the presence of copper and steel in the MAG Cincinnati Machine Thermal Stability Test.
- **Fast water separation** — Protects against rust problems by fast release of water.
- **Good filterability** — Excellent thermal and hydrolytic stability helps prevent formation of deposits which may interfere with filtration in equipment having close tolerances.

FEATURES

Rando HDZ oils incorporate antiwear additives, oxidation and corrosion inhibitors, foam and aeration suppressants, and a shear stable viscosity index improver.

Hydraulic systems, due to the nature of their operation, experience accelerated wear unless they are protected by clean, high quality antiwear hydraulic oils. Surging pressures in pumps and valves can increase metal-to-metal contact unless antiwear protection is present. The antiwear additives in Rando HDZ oils plate out on the metal surfaces. This plating minimizes metal-to-metal contact, which is most severe in vane-, piston-, and gear-type pumps. As hydraulic pressures increase over 1000 psi, the need for antiwear protection increases proportionally.

In laboratory efficiency testing, Rando® HDZ oils provided up to 5% improvement in overall hydraulic pump efficiency when compared to a typical monograde hydraulic oil like Hydraulic Oil AW (a lower VI product with VI<105).

APPLICATIONS

Rando HDZ oils are versatile lubricants available in multiviscosity ISO 15, 22, 32, 46, 68 and 100 grades. The multiviscosity feature promotes even and continuous power transmission over a wide temperature range with a minimum of shudder, and maximum accuracy.

They are recommended for hydraulic or circulating oil systems, including marine on-deck machinery, hydraulic actuated loading bins, or equipment that require a wider operating temperature as compared to a single viscosity grade oil.

Product(s) manufactured in the USA.
Always confirm that the product selected is consistent with the original equipment manufacturer's recommendation for the equipment operating conditions and customer's maintenance practices.

A **Chevron** company product

29 July 2016
IO-174

Rando HDZ oils are approved for:

- **Eaton-Vickers** I-286-S, M-2950-S, 35VQ25A (ISO 32, 46, 68)
- **Fives Cincinnati** (formerly MAG Cincinnati, Cin Machine, Cin Milacron) P-68 (ISO 32), P-70 (ISO 46), P-69 (ISO 68)
- **Parker Hannifin (Denison)** HF0, HF1, HF2, using T6H20C pump (ISO 32, 46, 68)

Rando HDZ oils meet the requirements of:

- **Arburg** (ISO 46)
- **ASTM** D6158, HV (ISO 15, 22, 32, 46, 68, 100)
- **Bosch Rexroth** former specification RE 90220-01 (ISO 32, 46, 68)
- **DIN** 51524-3 (ISO 15, 22, 32, 46, 68, 100)
- **Frank Mohn, Framo** hydraulic cargo pumping (ISO 46)
- **ISO** 11158 L-HV (ISO 15, 22, 32, 46, 68, 100)
- **JCMAS** HK-1 (ISO 32, 46)

In a clean, dry environment, Rando HDZ 15, 22, 32, 46, 68 and 100 typically meet a dielectric strength of 35 kV[a] (ASTM D877[b]).

Refer to the service manual of the equipment to ensure that the minimum fluid viscosity requirements are met at the highest operating temperature. Please consult with your equipment manufacturer if equipment is operating outside normal operating conditions.

Do not use in high pressure systems in the vicinity of flames, sparks and hot surfaces. Use only in well ventilated areas. Keep container closed.

Always confirm that the product selected is consistent with the original equipment manufacturer's recommendation for the equipment operating conditions and customer's maintenance practices.

TYPICAL TEST DATA

ISO Grade	15	22	32	46	68	100
Product Number	*273282*	*273264*	*273260*	*273261*	*273262*	*273263*
SDS Number	*23543*	*23537*	*23537*	*23537*	*23537*	*23537*
API Gravity	28.4	31.7	33.1	32.2	31.1	30.9
Viscosity, Kinematic						
cSt at 40°C	16.0	22.5	32.0	46.0	68.0	100.0
cSt at 100°C	3.9	5.1	6.3	8.2	11.0	14.2
Viscosity, Saybolt						
SUS at 100°F	81.4	108	150	214	316	464
SUS at 210°F	39.1	43.0	46.9	53.1	62.8	74.8
Viscosity Index	140	160	153	153	154	145
Flash Point, °C(°F)	150(302)	188(370)	220(428)	216(420)	212(414)	232(450)
Pour Point, °C(°F)	-54(-65)	-53(-63)	-50(-58)	-45(-49)	-42(-44)	-39(-38)
Brookfield Viscosity, ASTM D2983, cP at -20°C	500	750	1290	2330	4450	8040
Brookfield Viscosity, ASTM D2983, cP at -30°C	1660	2340	4900	9120	19300	—
Brookfield Viscosity, ASTM D2983, cP at -40°C	6920	9120	25100	—	—	—
Oxidation Stability Hours to 2.0 mg KOH/g acid number, ASTM D943	—	—	>5000	>5000	>5000	>3000
Dielectric Strength, kV[a], ASTM D877[b]	35	35	35	35	35	35

a Dielectric strength value applies only to "point of manufacture" of packaged products produced at a Chevron manufacturing facility. (Does not apply to bulk packaging). The oil will quickly lose its high dielectric strength value when exposed to contamination and to very small amounts of moisture and water.

b Industry standard test method for measuring kV values is not precise and test results can differ significantly.

Minor variations in product typical test data are to be expected in normal manufacturing.

Always confirm that the product selected is consistent with the original equipment manufacturer's recommendation for the equipment operating conditions and customer's maintenance practices.

29 July 2016
IO-174

Always confirm that the product selected is consistent with the original equipment manufacturer's recommendation for the equipment operating conditions and customer's maintenance practices.

CHEVRON SOLUBLE OIL B

PRODUCT DESCRIPTION

Chevron Soluble Oil B is used broadly in machine shops as a multifunctional cutting fluid. It is primarily formulated to cool and lubricate the contact point of the tool and the work piece.

CUSTOMER BENEFITS

Chevron Soluble Oil B delivers value through:

- **Minimal separation** — Excellent emulsion even with hard water
- **Good rust protection** for steel work and machined parts even when water/oil emulsion ratios are 80:1
- **Cooling** maximized by metal wetting. In addition, promotes good chip settling.
- **Minimal foaming** — Possibility of sump overflow minimized
- **Good stability in storage** — Minimal tendency to turn rancid
- **Good ability to control bacterial growth and rancid odors**

FEATURES

Chevron Soluble Oil B:

- helps prevent rusting or corrosion of the machined metals
- helps control the growth of bacteria — which is a constant problem in soluble oil circulating systems due to outside contamination
- minimizes surface foam
- speeds the release of entrained air which could cause pump cavitation

This is an extremely versatile fluid designed to meet many of the situations encountered in the metalworking industry.

Chevron Soluble Oil B is an emulsifying oil that readily mixes with water, forming a homogeneous and exceptionally stable emulsion. It is used in the machining of both ferrous and nonferrous metals, particularly when cutting with carbon or high speed steel or tungsten carbide tools. It contains an effective biocide that combats bacterial growth, rancidity, and odor in machine sumps.

APPLICATIONS

Chevron Soluble Oil B is recommended for metals (except magnesium) where maximum cooling is desired — particularly when cutting with carbon, high speed steel, or tungsten carbide tools.

Chevron Soluble Oil B is used extensively in milling, drilling, gear cutting, turning, planing, shaping, sawing, and grinding operations.

Chevron Soluble Oil B is typically diluted in water/oil ratios ranging from 10:1 to 50:1. See the Chevron Soluble Oil Mixing Recommendations chart for the proper water/oil ratio for each application.

Always add oil to water to avoid forming sticky invert emulsions that do not emulsify properly in water.

Chevron Soluble Oil B provides excellent in-process corrosion protection. Use of this product as a metal protective fluid for short-term rust protection is not recommended.

Do not recommend Chevron Soluble Oil B emulsions for operations involving magnesium. Hot magnesium is a fire hazard when it contacts water.

Emulsions of soluble metalworking fluids and water may become contaminated with harmful microorganisms such as bacteria and fungus, which can cause illness and infection. This can occur even in emulsions with fluids that initially contain some biocide because the biocide can be depleted during service. A metalworking fluid maintenance program should be followed in order to control this hazard. Such a program may require the use of biocides.

Product(s) manufactured in the USA.
Always confirm that the product selected is consistent with the original equipment manufacturer's recommendation for the equipment operating conditions and customer's maintenance practices.

A **Chevron** company product

12 May 2016
MWF-40

TYPICAL TEST DATA

	B
Product Number	*233703*
SDS Number	*7090*
API Gravity	21.6
Viscosity, Kinematic cSt at 40°C cSt at 100°C	 38.0 5.2
Viscosity, Saybolt SUS at 100°F SUS at 210°F	 198 43.7
Flash Point, °C(°F)	160(320)
Pour Point, °C(°F)	-30(-22)
Total Sulfur, wt %	0.30
Active Sulfur, wt %	None
Volatile Organic Content (VOC), g/L ASTM E-1868-10	44

Minor variations in product typical test data are to be expected in normal manufacturing.

Always confirm that the product selected is consistent with the original equipment manufacturer's recommendation for the equipment operating conditions and customer's maintenance practices.

12 May 2016
MWF-40

MIXING RECOMMENDATIONS

First figure indicates parts of water. Second figure indicates parts of Chevron Soluble Oil B.

Material	Turning, Shaping, Planing, Drilling	Milling	Pipe and Plain Threading	Automatic Screw Machines	Grinding	Thread Grinding	Deep Drilling	Gear Shaving or Cutting
Plain, medium, and high carbon steels	20:1	20:1	→	20:1	50:1	20:1	→	20:1
Alloy steels	15:1	15:1	→	15:1	50:1	15:1	→	15:1
Ingot iron, wrought iron, low carbon steels	15:1	15:1	→	15:1	50:1	15:1	→	15:1
Stainless steels, tool and die steels	10:1	10:1	→	10:1	50:1	10:1	→	10:1
Aluminum and aluminum alloys	25:1	25:1	30:1	30:1	50:1	30:1	20:1	30:1
Copper and brass	25:1	25:1	30:1	30:1	→	→	20:1	30:1
Zinc and zinc alloys	25:1	30:1	30:1	30:1	→	→	20:1	→
Bronze and high strength copper alloys	10:1	10:1	10:1	10:1	50:1	10:1	→	10:1
Magnesium and magnesium alloys	**FIRE HAZARD**							
Titanium and titanium alloys	10:1	10:1	→	→	→	→	→	→
Nickel and nickel alloys	10:1	10:1	→	10:1	50:1	10:1	→	10:1
Cast iron	Dry	Dry	Dry	→	Dry	Dry	Dry	Dry

→ Seldom used.

Emulsions of soluble metalworking fluids and water may become contaminated with harmful microorganisms such as bacteria and fungus, which can cause illness and infection. This can occur even in emulsions with fluids that initially contain some biocide because the biocide can be depleted during service. A metalworking fluid maintenance program should be followed in order to control this hazard. Such a program may require the use of biocides.

Always confirm that the product selected is consistent with the original equipment manufacturer's recommendation for the equipment operating conditions and customer's maintenance practices.

Always confirm that the product selected is consistent with the original equipment manufacturer's recommendation for the equipment operating conditions and customer's maintenance practices.