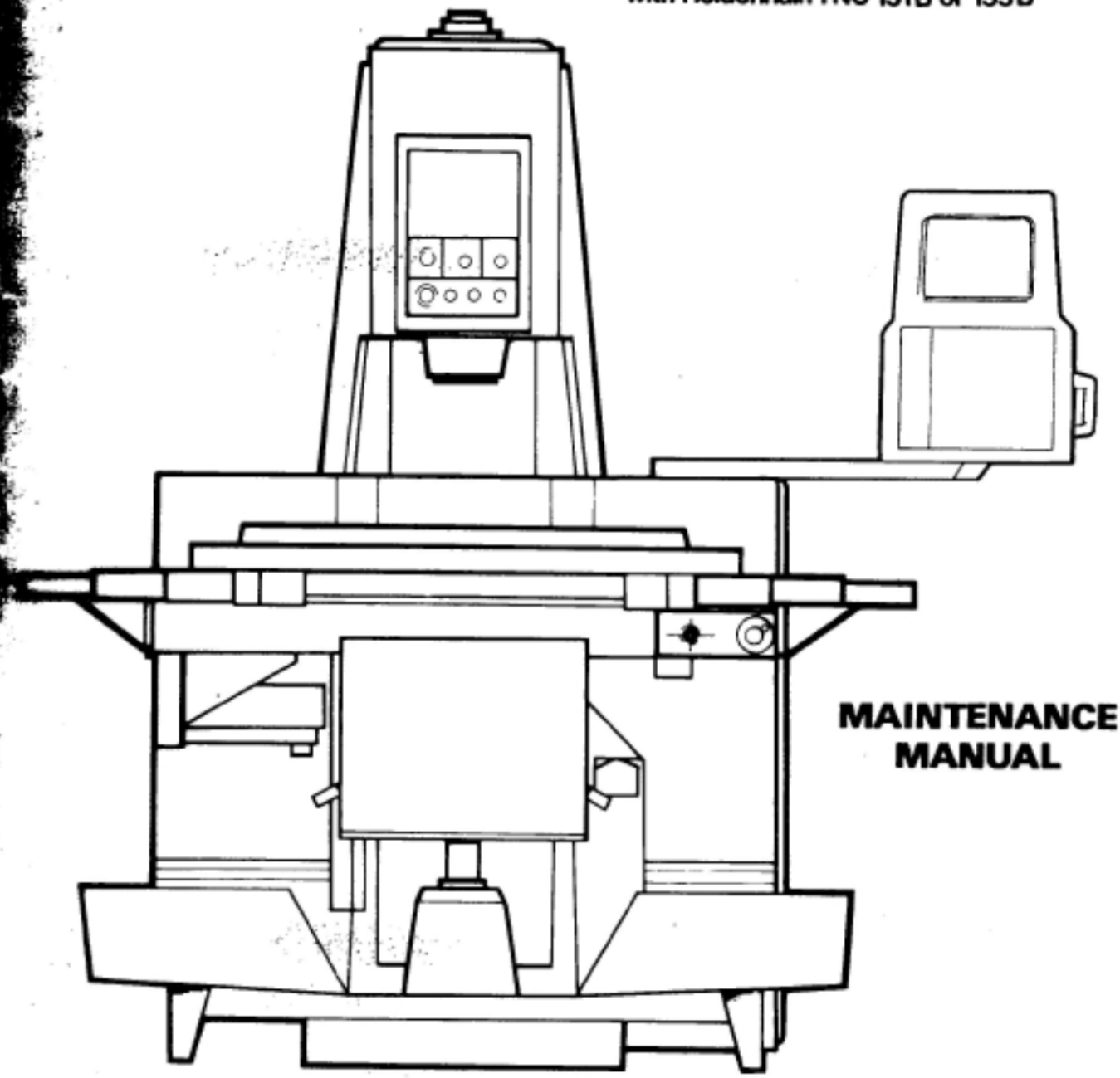
Bridgeport

SERIES II INTERACT 4
Milling machine

with Heidenhain TNC 151B or 155B



MAINTENANCE MANUAL

PART NO. 1800045

PART NO. 1800045

INSTALLATION & MAINTENANCE

MANUAL

FOR THE

SERIES II INTERACT 4

with Heidenhain TNC 151B or 155B

MILLING, DRILLING & BORING MACHINE

November, 1987

IMPORTANT

SAFETY NOTICE – BRIDGEPORT SERIES II INTERACT 4

PERFORM ALL ACTIONS IN THE MANNER STATED IN THIS MANUAL.

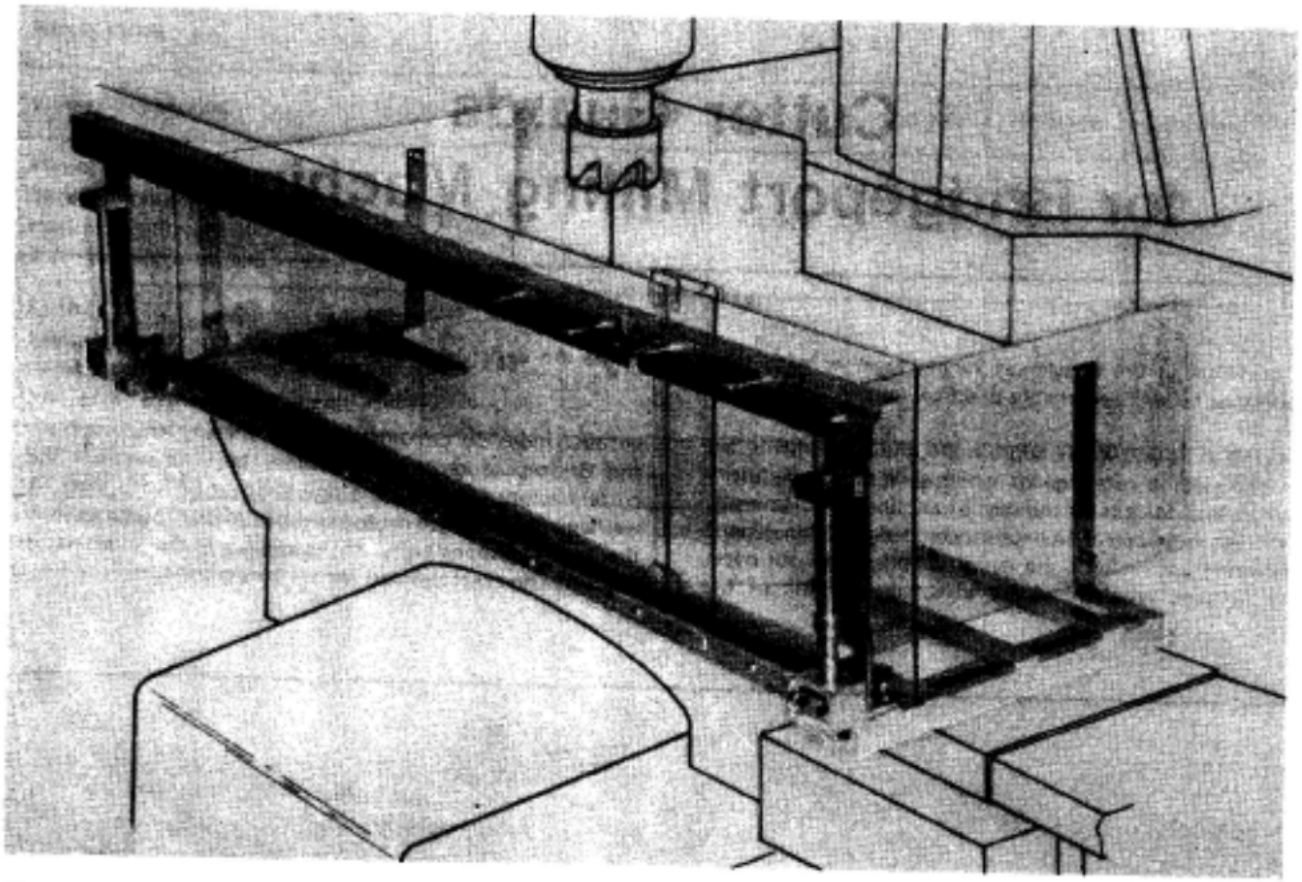
NEVER OPERATE THE MACHINE WITHOUT PROPER CUTTER GUARDING.

ENSURE YOU KNOW HOW TO STOP YOUR MACHINE.

DO NOT TAMPER WITH THE MACHINE.

KEEP MACHINE AND SURROUNDING AREA CLEAN AND TIDY.

GUARDING



The guard supplied as standard equipment with the Bridgeport Series II Interact 4 (pictured above) is made of a clear material (Lexan or equivalent) having high impact resistance to provide operator safety and a clear unobstructed view of the component and cutter. A door at the front allows easy access for tool changing or loading of components. This guard IS NOT SUITABLE FOR ALL OPERATIONS of which the machine is capable, and great care should be taken to ensure the guard you use is safe for the operation being performed.

LEAVE NOTHING TO CHANCE - CHECK THE GUARD BEFORE YOU START THE MACHINE.

Attention is drawn to the requirements of the Health and Safety at Work Act 1974 which applies to the UK. Similarly in other countries the machine should always be operated to conform with the appropriate regulations.

IMPORTANT

This information is relevant to the HEALTH AND SAFETY AT WORK ACT

Cutter Guards for Bridgeport Milling Machines

All machines in the Bridgeport range, together with their accessories are designed and produced to ensure safety to the operator as far as is reasonably practicable.

Every machine and where appropriate, the attachments, are provided with a cutter guard which will satisfy statutory requirements for a large number of applications. However, as the machine and attachments are designed for general engineering applications the guard supplied will not cover every possible requirement for effective guarding of the cutter. Under no circumstances should any machine from the Bridgeport range of machines be used without the correct safety guard for the operation to be performed. As we have no control over the end use of our machines, it is the user's responsibility to ensure that the machine is properly used and guarded for every operation.

Bridgeport

Bridgeport Machines
P.O. Box 22, Forest Road,
Leicester LE5 0FJ, England
Telephone: (0533) 531122; Telex: 34598

IMPORTANT

ELECTRICAL MAINS SUPPLY – CABLE INSTALLATION REQUIREMENTS BRIDGEPORT INTERACT MILLING MACHINES						
MACHINE TYPE	**SERIES I INTERACT SERIES II INTERACT 2**		**SERIES I INTERACT MK 2**		**SERIES II 4**	
Supply rating	5 KA		20 KVA		25 KVA	
Voltage Connection	380/460	200/230	380/460	200/230	380/460	200/230
Power Main power supply to machine electrical panel – wire cross sectional area	4 mm	4 mm	4 mm	10 mm	6 mm	10 mm
Earth Factory Main Power Board to the machine earth connection covered wire cross sectional area	6 mm	6 mm	6 mm	10 mm	6 mm	10 mm
Main Fuses Minimum rating	30 amp	30 amp	30 amp	50 amp	35 amp	60 amp
WARNING – Connections should only be made by a qualified electrician and in accordance with local safety regulations.						

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CONTENTS (cont.)

LIST OF ILLUSTRATIONS

1 MACHINE INSTALLATION

1.1 UNCRATING (WHERE NECESSARY)

Carefully remove the outside casing, internal braces and skids so that the machine is not damaged in any way.
If any damage has been caused in transit please inform:

i) the haulage contractors
ii) the railways and/or shippers
iii) or local agent

and state the full extent of the damage. Retain all the packing materials until the Insurance Company's assessors have inspected the machine.

1.2 SHORTAGES PROCEDURE

Check all the equipment with the Packing Sheet or Delivery Note. If any shortages are evident or suspected, please inform Bridgeport Textron or your local agent.

1.3 LIFTING

1.3.1 Weight

Basic machine approximately 2545 kg or (4,480 lb).
Ensure pendant arm is locked in front position shown. Remove back, top, and both side covers. Place 38 x 762 mm (1½" x 30") long bar through head casting. Before raising off the ground, test for balance. Figure 1.1 clearly depicts the method of slinging.

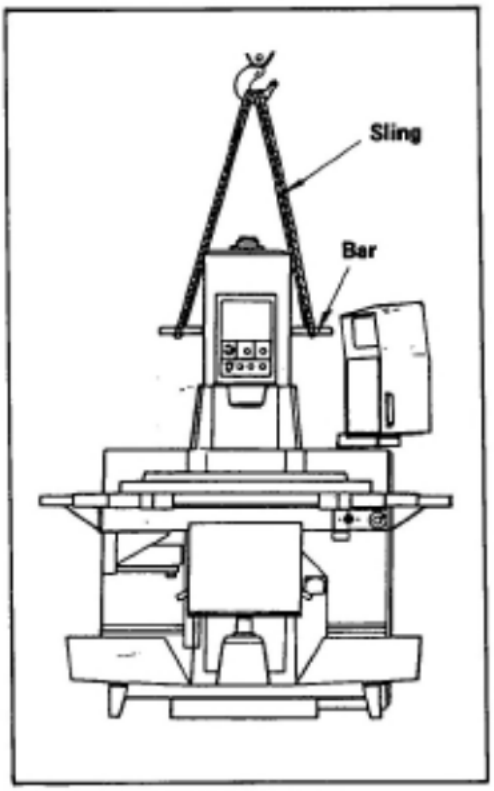


Figure 1.1 Slinging

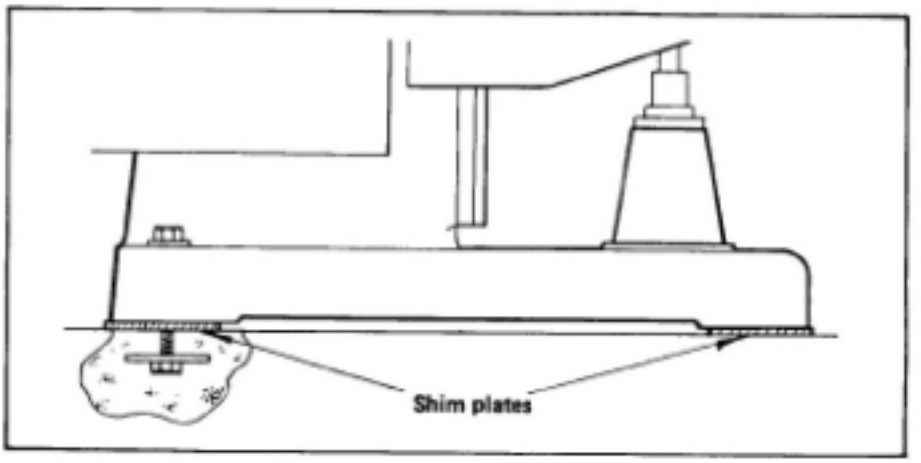
1.4 PREPARATION OF THE MACHINE LOCATION

1.4.1
Foundation and clearances

When setting the machine on a prepared foundation of concrete (optional) or on the shop floor, use shim plates, adjustable mounting pads or thin grouting to compensate for unevenness in the floor.

Figure 1-2 shows the base dimensions and the 17 mm (21/32") diameter clearance holes for 16 mm (5/8") bolts, should it be required to bolt the machine to the floor.

Figure 1-3 shows the necessary clearances around the machine for access door opening for maintenance and to continue the remainder of the installation.



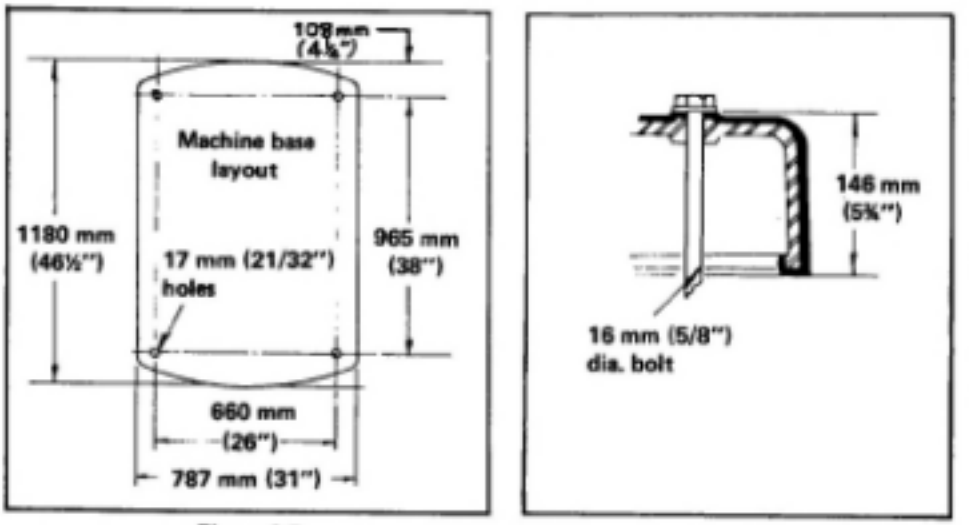


Figure 1.2

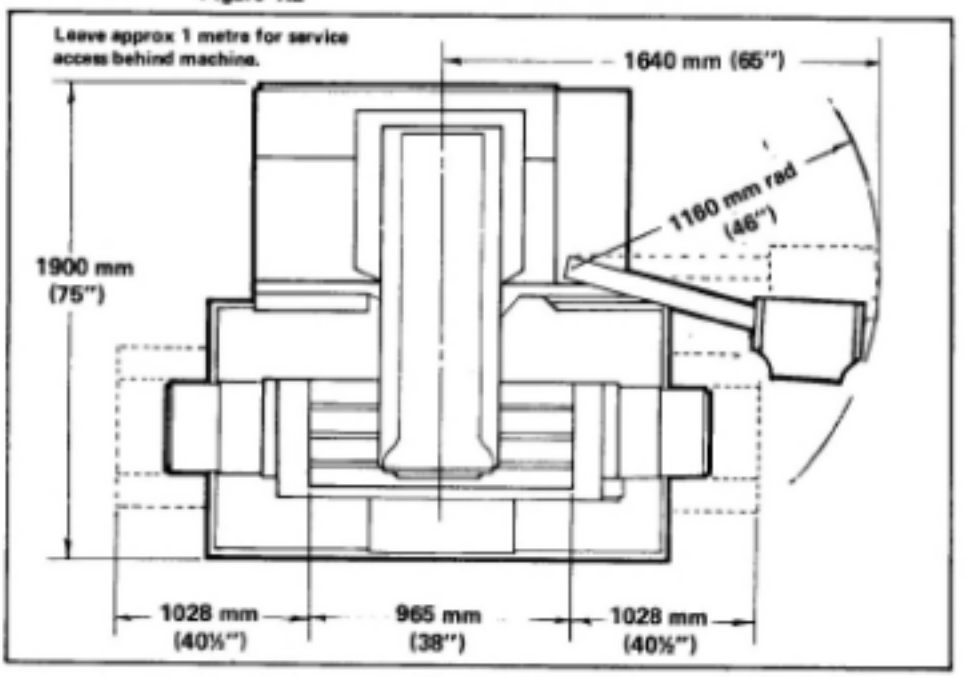


Figure 1.3

1.MACHINE INSTALLATION (cont.)

1.5 ELECTRICAL SERVICE

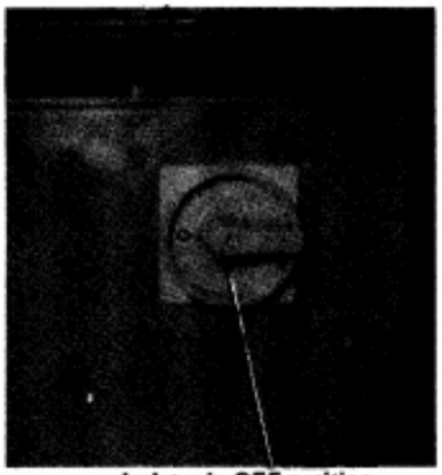
1.5.1
Reference information
There are two electrical cabinets on machines supplied. Check the label on the outside of the side cabinet to determine the exact figures for your installation.

1.5.2
Side cabinet (feed panel)
This cabinet is wired for 210, 220, 240, 380 or 400, 420, 440, 460, 480 v and main fuses MF1, MF2, MF3 are 20 amps.

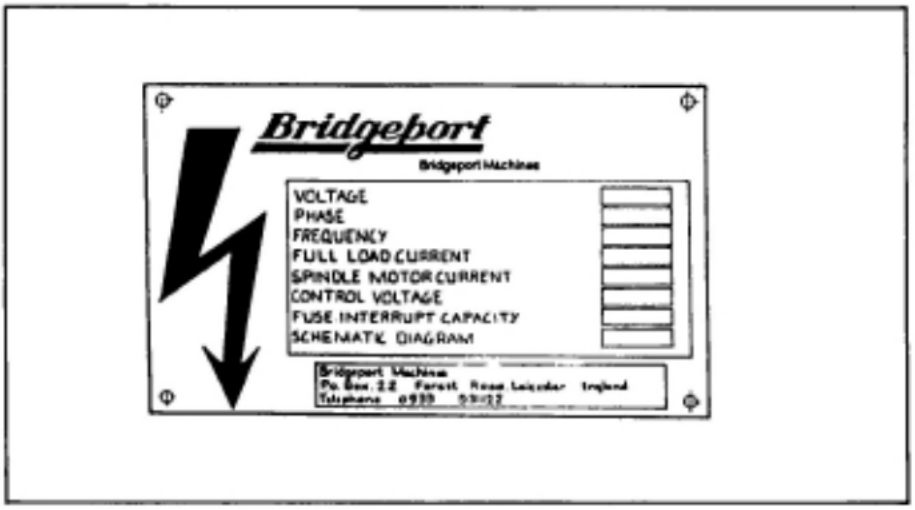
1.5.3
Spindle drive cabinet
This cabinet is located at the rear of the column and is wired for **HIGH** or **LOW** voltage supply.

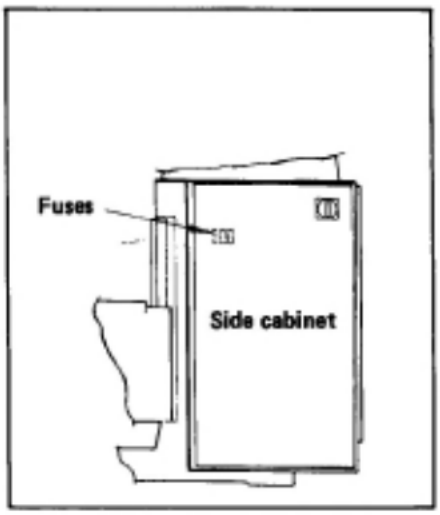
i) **HIGH** voltage supply is 380 volts to 460 volts. CBI is selected to be 32 amps.
ii) **LOW** voltage supply is 200 volts to 240 volts. CBI selected to be 50 amps.

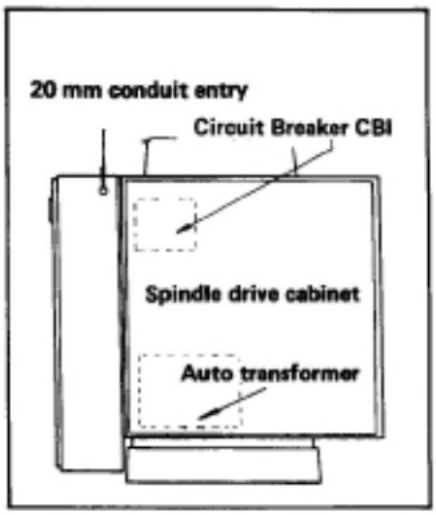
WARNING:
Do not connect electrical supply at this stage.



Isolator in OFF position







NOTE

Customer power requirement
The peak power requirement of the machine is 25 KVA.

Customer fuse requirement

i) **HIGH** voltage machine(380 to 460v) requires a minimum fuse size of 35 amps.

OR

ii) **LOW** voltage machine (200 to 240v) requires a minimum fuse size of 60 amps.

2. PREPARATION FOR OPERATION

2.1 CLEANING THE MACHINE

WARNING:
Do not use gasoline, chlorinated hydrocarbons or any other inflammable or toxic cleaning agent.

Clean all rust preventative from the machine with kerosene/white spirit and lubricate all exposed sections of the table, saddle and knee ways. This includes the underside of all ways. It also includes the possible necessity to scrape paint from some of the hidden surfaces where the masking may not have been completely effective.

2.2 LUBRICATION

There are two classes of lubrication system
i) Those areas lubricated for life such as spindle bearings, transmission gearbox etc.
ii) The forced lubrication system from the automatic one-shot pump to supply ways, gibs and ballscrews including the Z axis (see Figure 2-1).

2.3 COOLANT

The coolant reservoir has a capacity of approximately 20 litres (4.4 gallons). Pour in the required type of coolant to the base of the machine.

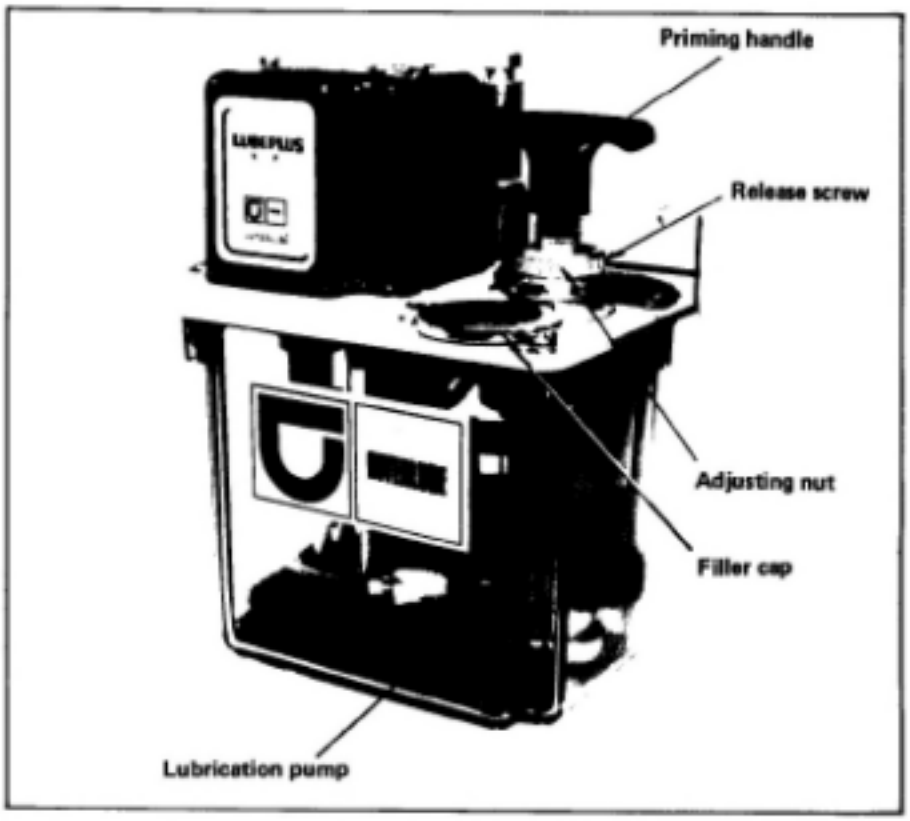


Figure 2.1 Automatic one-shot pump

3.MACHINE COMMISSIONING

3.1 GENERAL

Initial machine commissioning **must** be carried out by Bridgeport Field Service or their trained Dealer Service.
Electrical power **must not** be applied to the machine until requested by the Engineer carrying out the commissioning.

3.2 COMMISSIONING PROCEDURE

3.2.1
Preliminary inspection
The following checks are to be carried out before the machine main isolator is switched on.

OFF position

3.2.1.1
Visual inspection

i) Check the machine for any transit damage and check that all hardware fixings are secure.
ii) Check that all fuses are installed and are secure.
iii) Check that the lubrication reservoir has been filled with the correct grade of oil and operate the plunger to check that the system is pumping the lubricant.

Fuses **Side cabinet**

3.2.1.2
Wire checks

i) Check that **ALL** terminal strip screws in both cabinets are secure.
ii) Check that the D.C. feed motor connections are secure.
iii) Check that the connections to the head limit switches are secure.

3.2.2
Mains supply checks

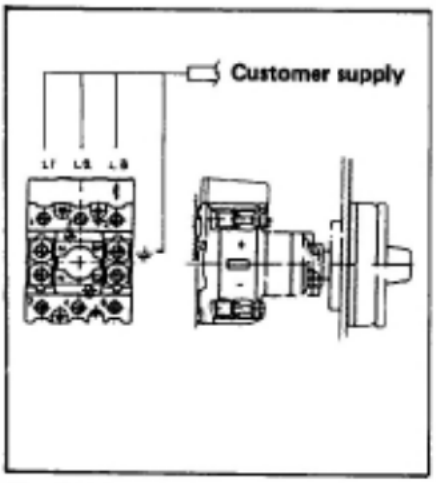
i) On connecting the mains 3 phase supply to the machine main isolator ensure that the phase rotation sequence is correct:—

Red	—	Yellow	—	Blue
L1		L2		L3

Note:— If the phase rotation is incorrect the spindle drive unit will not function and the spindle circuit breaker (CBI) may trip.

ii) Measure the incoming 3 phase supply on the supply side of the main isolator and record these readings below:

a) Lines L1 to L2 ..... volts A.C.
b) Lines L1 to L3 ..... volts A.C.
c) Lines L2 to L3 ..... volts A.C.



iii) Check with the customer for any known, regular variations of supply voltage which are widely different from the nominal values measured in (i) above.

vi) Check that transformers T1, T2 (located in the side cabinet) and T4 option if fitted are wired different from the correct supply voltage. T1 wire numbers 173 and 174, T2 wire numbers 111 and 112.
0/L1 in spindle cabinet is set for 22.5A
0/L2 in spindle cabinet is set for 0.4A
0/L3 in main cabinet is set for 6.0A

3.2.3
Electrical checks
Switch the main isolator ON and carry out the following electrical tests:

ON position

i) Measure the A.C. voltage between wire numbers 8 and 9, and check that it falls within the range 115 volt A.C. $\pm$ 5 volt.
Voltage reads . . . . . volts A.C.
ii) Measure the D.C. voltage between wire numbers 100 and 90 and check that it falls within the range 24 volts D.C. to 28 volts D.C.
iii) Measure the smoothed D.C. voltage terminals 65 and 90 and check that it falls within the range 22 volts D.C. to 26 volts D.C.
Voltage reads . . . . . volts D.C.

3.2.4
In the Spindle Drive
Check the direction of the spindle fan Measure the A.C. voltage on wire 200 — 201 . — 202 and ensure that the voltage is nominally 420v A.C.

3.MACHINE COMMISSIONING

3.2.5
Pneumatics
Set the respective pressure regulators to provide a nominal pressure of 80 psi (5.62kg/cm^2) to:–

i) The spindle brake and speed change pneumatics
ii) The air assisted knee **80 p.s.i.**

3.2.6
M.D.I. commands
Check the machine responds to MDI commands.

3.2.7
Lube
Check runs spindle to maximum in M03 and M04. Program spindle speed of 40 rpm and check spindle runs O.K.

3.2.8
Coolant
Check that the coolant system works.

3.2.9
L.V. Light
If fitted, check this function.

3.2.10
Test
Run test program through machine.

3.3 AXIS DRIVE SET UP CHECKS

In LAG mode

1 i. Change machine parameter 65 to 0.
ii. Set axis display to 0 for each axis.
iii. Adjust offset pot on drive unit if necessary until display reads 0.002 mm.
iv. Reset parameter 65 to 1.

2 i. Change parameter 60 to 1 and re-reference machine.
ii. Program machine to run axis in
iii. Adjust R23 (Tacho) on drive unit if necessary to give DRO reading that is balanced about 5,000, e.g., 4,975 in one direction and 5,025 in the other.
iv. Repeat for each axis in turn.
v. Reset parameter 60 to 0 and re-reference machine.

3.4 ACCURACY CHECKS

Before carrying out accuracy checks run machine at feed rate on all axes for 30 minutes to enable the machine to reach operating temperature.
Check backlash on machine.
If any backlash is apparent, change relev parameter for X axis 36, 7 axis 37, Z axis 38 to zero (0). Check backlash again and enter new figure in microns into parame and amend parameter record sheet.
Finally, complete machine record sheet coverage and return to Service Departme in Leicester or Local Dealer Service offic for records.

MACHINE INSTALLATION RECORD

Machine Serial No . . . .

TNC Type . . . .

Software No. . . . .

Customer Name . . . .

Address . . . .

. . . .

. . . .

Telephone . . . .

Contact . . . .

Before switching machine isolator on
MAINS SUPPLY CHECKS
Customer supply
Check phase rotation sequence red – yellow – blue; L1 – L2 – L3

L1 – L2		Volts A.C.
L2 – L3		Volts A.C.
L1 – L3		Volts A.C.

Known Variations

Equipment wired for . . . . Volts

After Machine Isolator Power On

Transformer T1 Primary Secondary

Primary	Secondary	
Volts Ac	Volts AC	Wire 117.0V (NOM 115)
	Volts AC	Wire 114.0V (NOM 27V)

Spindle Drive Cabinet

200 – 201 (NOM 420V AC)
201 – 202 (NOM 420V AC)
200 – 202 (NOM 420V AC)

D.C. Voltage

Wire 100 – 90		(NOM 24V DC)
Wire 65 – 90		(22 – 26V DC)

MDI Functions O.K.
Lube Functions O.K.
Coolant Functions O.K.
Program run O.K.

COMMENTS

Signed. . . . . Date . . . .

4.MACHINE MAINTENANCE THEORY OF OPERATION

4.1 THE XY SERVO MOTOR DRIVE

4.1.1
Servo motors
The feed motors are of the permanent magnet type driven by silicon controlled rectifier drive cards situated in the electrical cabinet.
A 125 line/revolution encoder is mounted on the back of each motor and provides the position feed back signal.

4.1.2
Transmission
The X and Y motions of the table are accomplished by means of hardened and preloaded 5 mm pitch ballscrews with recirculating ball nuts. On the X axis the ball nut is fixed to the saddle and the D.C. motor turns the screw through a 2:1 reduction timing belt drive.
The Y axis is similar, the drive being to the rear of the screw to give operator access to the work area.

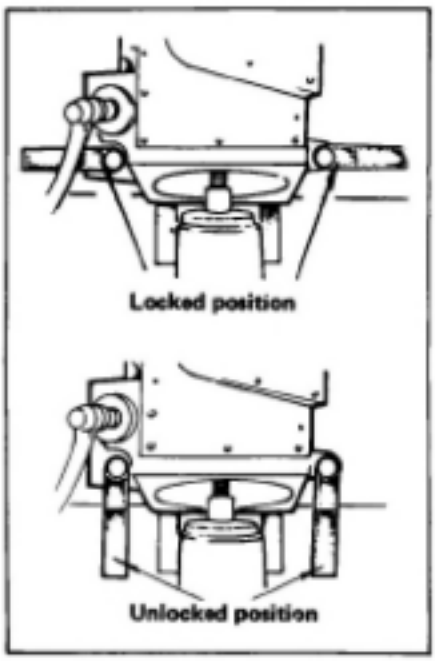
4.2 KNEE DRIVE

NOTE:
Two knee lock levers which control clamps on the knee-column ways must be released prior to raising and lowering the knee.

4.2.1
Raising and lowering knee
The knee is elevated by an Acme screw. A dual dial, calibrated in increments of .01 mm (.001") is provided.
To change knee elevation push the knee elevating crank in until the clutch meshes, then turn the crank clockwise to elevate the knee, or counter-clockwise to lower it.

Knee elevating crank

4.2.2
Clamping the knee
To clamp the knee, turn the knee lock levels firmly upwards. To release, turn them the other way. Keep the knee clamped while cutting.



Locked position

Unlocked position

4.3 LUBRICATING SYSTEM

All moving members are fed from a central lubricating tank containing a filter and motorised pump.
To distribute and retain the oil on the table, saddle and knee, grooves are cut into the face of the ways and through holes in the gib so that both sides of the dovetail get full lubrication. Excess oil exudes over the edge of the ways between the moving members.
Spindle bearings are grease-packed and require no additional lubrication for the life of the machine. Low level lube will not stop a job in progress but it will prevent the feed from being started for the next job.

4.3.1
Required lubricants

Mobil Oil	Vactra Oil No. 2
Shell Oil	Tonna T68
ROC Lubricants	Dynobear 68
Castrol	Magna BD 68
Gulf Oil	Gulfway 68
Duckhams Oils	Adglide 68
Texaco	Way Lubricant 68
BP Trading	Maccurat 68
Esso	Febis K-53

4.4 THE Z AXIS DRIVE

The quill is driven by the same type of D.C. feed motor as used on the X and Y axis. A timing belt is used to connect the D.C. feed motor and the ball screw because of its excellent performance characteristics for this application. The ball screws are hardened and ground with a 5 mm pitch thread carrying a recirculating ball type nut with suitable internal preload.

4.5 SPECIFICATION

Table	
Table size	1200 x 420 mm
Working surface	965 x 381 mm
Longitudinal travel	760 mm
Cross travel	370 mm
Vertical travel (manual knee setting)	335 mm
Power feed range	1 - 5000 mm/min.
Power feed increments	infinitely variable
Rapid traverse	5000 mm/min.
Number of tee slots	3
Width of tee slots	15.9 mm
Centres of tee slots	111 mm
Maximum workpiece load	405 kg
Spindle	
Taper	Bristol Erickson quick change No. 40 ISO
Speed range	40 - 4000 rpm
Quill travel	150 mm
Control	
Type	Heidenhain 151B or 155B
Position feed back	Rotary encoder
System resolution	.001 mm
Display resolution	.005 mm

5. POWER DISTRIBUTION

5.1 INPUT SUPPLY

Prime power to the system is 3 phase, 50/60 Hz. A.C. input voltage is selected by the customer when ordering the machine. Minor voltage adjustment can be made in the field to cope with local differences from the specified voltage. Available input voltages are 210, 220, 230, 380, 400, 420, 440, 460 and 480 v.

5.1.1

Three phase power

Three phase power enters the system through the main system disconnect located on the electrical cabinet and feeds the 3 phase distribution wiring.
Items connected to the 3 phase distribution wiring are:

i) The spindle motor drive unit
ii) Control voltage transformer (T1).
iii) Axis drive power transformer (T2).

5.1.2

Single phase power

The 110 volt single phase output from T1 feeds the single phase distribution wiring. Items fed from the single phase distribution are as follows:

i) Spindle and feed contactors.
ii) Lube pump motor.
iii) Coolant pump motor

5.1.3

24 volt D.C. power

24 volt D.C. power is used for general purpose switching and control functions in which close voltage regulation is not important. These include:

i) The 24 volt D.C. regulator which produces the smoothed 24 volt D.C. for the MDI control.

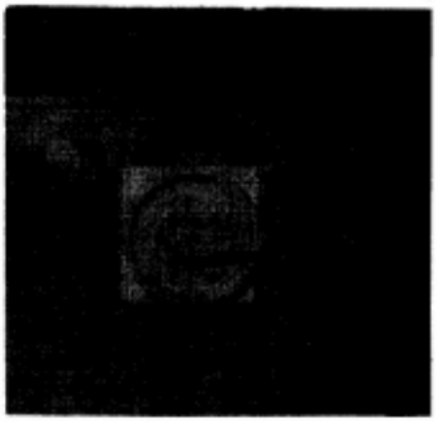
6. CONTROL AND AXIS DRIVES

6.1 AXIS DRIVE UNIT SYSTEM DESCRIPTION

Power to each feed motor is provided by an S.C.R. feed drive unit situated in the electrical cabinet.
The main power input to the feed drive unit is a 180-0-180 volts A.C. supply derived from transformer T2 and applied to terminals U and V on the drive card via smoothing chokes L1, L2, L3 for X, Y, Z axis drives respectively.
Each drive unit produces a D.C. supply which appears at terminals C and D. The D.C. motor armature is connected between these terminals and the zero volt tapping of T2. Control of the D.C. voltage to the motor is by means of the input command voltage from the MDI control which is fed to the drive unit on terminals 7 and 9 for each of the three axes.
Each motor has an integral tachometer whose signal is input to the respective drive at terminals 4 and 6 to close the velocity feedback loop.

6.2 REPLACEMENT OF AXIS DRIVE UNIT

i) Switch **off** and isolate the machine.



Isolator in OFF position

ii) Remove the old drive unit after removing the plug-in terminal strip connector, the push-on power cable connectors and the screw down earth cable connection.

iii) Reverse the procedure to fit the new drive unit ensuring that all electrical connections are correct to the circuit diagram.
Remove the plug-in compensation card from the new drive and check the following components **before** switching on with the new drive.

R24 = 10K	R34 = not fitted
R25 = 27K	C17 = not fitted
R26 = 27K	C18 = 0,068 MF
R27 = not fitted	C19 = not fitted
R28 = 270K	C27 = not fitted
R29 = 120K	

Link ZF is to be cut.
The three 60Hz links on the card are to be fitted when the machine is to be operated on a 60Hz supply.
Using a digital multimeter, adjust potentiometer R30 (strom) to give a resistance reading of approximately 52K between pins X7/3 and X7/9.
Adjust potentiometer R23 (Tacho) to give a resistance reading of approximately 1,4K between X8/4 and the end of R24 nearest the edge of the card. Re-insert the card into the drive.
The new drive must now be adjusted.

iv) Remove wires 5, 6, 7 from main terminal block in the side cabinet.

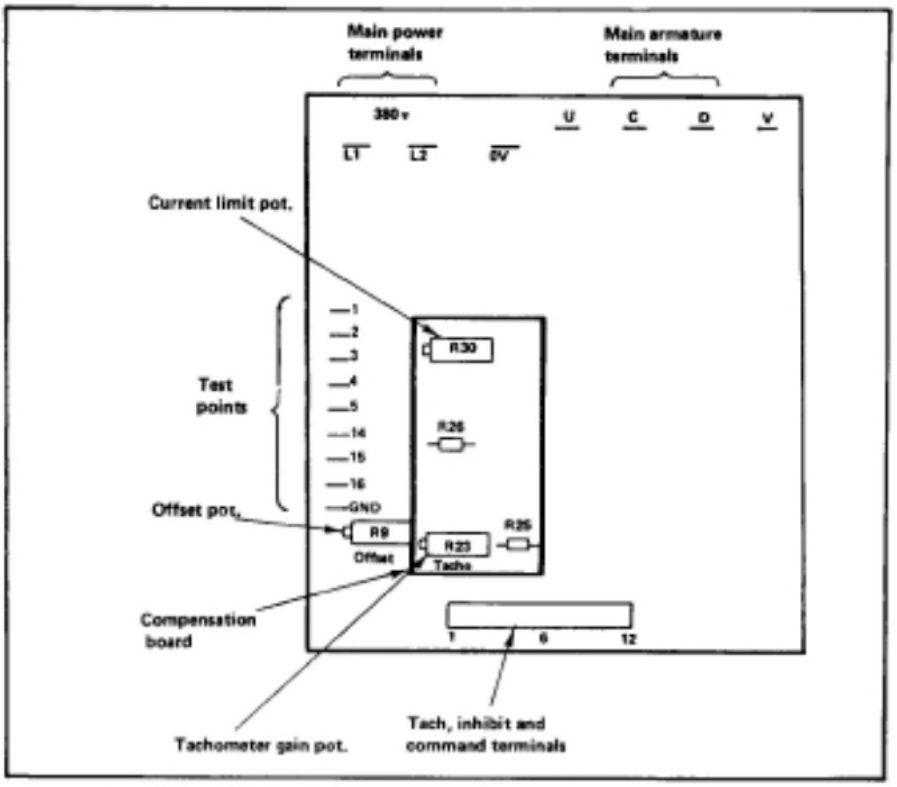


Figure 6.1 Axis drive unit connections and adjustments

v) Switch **on** isolator, press [CE] button on control unit. Display will show "PASS OVER REFERENCE POINTS"
In manual mode, press [MDI] key until "CODE NUMBER =" is displayed.

vi) Enter figure 95148 and [INPUT] control unit will transfer into MACHINE PARAMETER mode.
Alter parameter 59 to:
0 for setting X axis drive
6 for setting Y axis drive
14 for setting Z axis drive
Press [RESET] button on control to change back to PASS OVER REFERENCE POINTS mode.

vii) Set current limit on drive.
Turn the feedrate control and % override control on pendant fully clockwise.
Connect a d.c. voltmeter between test point 5 and ground (GND) on the drive being set.
Press programme start button on pendant and adjust R30 potentiometer on drive until the voltage reads
± 4.8 volts for 50Hz machine
± 5.9 volts for 60Hz machine.

viii) Press programme stop button, alter parameter 59 back to 14 switch **OFF** at isolator, remove the d.c. voltmeter and reconnect wires 5, 6, 7 to overload 3

ix) Switch **ON** and reference machine as normal.
In manual mode, press [MDI] key until "POSITION DATA" is displayed.
Press [SHIFT] key until "ACTL" mode is displayed.

Alter machine parameter 65 to 0. The display will alter to 1um resolution. Set display to zero. Adjust offset potentiometer R9 on drive until the display figure reads 0.000 or the last figure oscillates from 0 to ± 2. Change machine parameter 65 to 1.

x) Change machine parameter 60 to 1. Switch **OFF** then re-reference. Press [MOD] key until "POSITION DATA" is displayed. Press [Z+C] until "LAG" is displayed. The X, Y, Z displays will become zero.
Set up programme to rapid the relevant axis and set cycling. With the % override control to fully clockwise adjust tacho potentiometer R23 on drive until DRO reading is approximately balanced about 5.000 in both directions (Reading to be within 4.975 in one direction 5.025 in opposite) Stop the program. Press emergency stop, then release it. Change parameter 60 to 0. The OHF machine will display "SWITCH OFF THEN ON AGAIN".
The new drive is ready for operation.

6.3 CONTROL SYSTEM DESCRIPTION

The control unit has facilities for automatic cycling of the machine from the stored programme and for interlocking of the power feed controls.
It is a closed loop feedback system. This facility being achieved using a digital encoder on the rear of each motor.
Boundary parameters such as slide rapid traverse rates, slide lost motion values and software limits to traverses must be entered into the control at machine build and are retained even with the machine power off by a battery back-up system.

NOTE:
The batteries are housed behind a cover plate on the front of the unit. Batteries must only be removed if the machine power is **ON**. Otherwise the boundary parameters are lost

6.4 FITTING A NEW CONTROLLER

Before removing the old controller, check that the Machine Software Parameter Record sheet is correct (this can be found in the door pocket of the electrical cabinet). With the controller in its normal mode, press [MOD] until "CODE NUM. =" is displayed. Key 95148 and [↵] the machine parameter will be displayed and can be stepped through with the cursor button [↓]
If necessary amend the record sheet.

i) Switch **off** the machine and isolate it.
ii) Remove the pendant box rear cover to expose the back of the controller. Remove the 110 volt supply (wire numbers 8 and 9) and earth wires from the 3 way terminal block. After removing the terminal box cover plate gently prise away the 6 terminal strips together with their associated wiring. Unplug the 4 encoders (5 if fourth axis option fitted) leads marking them for ease of replacement viz top is X axis, second is Y axis, third is Z axis (quill) fourth is B axis, bottom is electronic handwheel. Unplug the programme storage interface lead and VDU lead.
iii) Carefully support the controller and remove the 4 mounting screws.
iv) Withdraw the controller from the front of the pendant.
v) Offer up the new controller and whilst supporting it replace the 4 mounting screws.
vi) Fit the 1 amp fuse supplied with the new controller.
vii) Set the voltage selector on the rear of the new controller to 120 volts.
viii) Replace the 110 volt supply and earth wires in the 3 way terminal block being careful to ensure the correct polarity. Plug in the 6 terminal strip connectors.
ix) Replace the 4 (5) encoders in their correct sockets.
x) Replace the programme storage interface and VDU leads.
xi) Switch **ON** the machine will now read "OPERATION PARAMETERS ERASED". If not then input 95148 ,and press [↵]
xii) The control will then display "MACHINE PARAMETERS"
xiii) Enter the values as recorded on the Machine Software Parameter record.

6.5 SOFTWARE LIMITS

After changing a feed motor, a feed drive belt, or an axis limit switch it is necessary to reset the software limits and reference switch on the axis concerned.
Proceed as follows:

i) Switch **ON** the isolator and pass over reference points in the normal manner. If during reference procedure the control unit displays "WRONG REFERENCE POINT" then switch **OFF** and rotate the relevant axis motor pulley by 180° on motor shaft and re-reference.
Set the control unit in metric and put the TNC into reference mode by pressing [MOD] until "POSITION DATA" is displayed. Press [↵] until "REF" is displayed.
Adjust the relevant reference switch dog to operate the reference switch at between -1.0 mm to -1.5 mm as read on the corresponding readout display.
The operation can be more accurately checked by connecting a voltmeter between terminal 90 and terminal 79 (X) or 80 (Y) or 81 (Z).
ii) For the relevant axis only, increase the machine parameter below by 5 mm:
For the X axis increase parameter 43
For the Y axis increase parameter 45
For the Z axis increase parameter 47
Using the electronic handwheel, gently feed the axis in the positive direction until it just trips the extreme limit (i.e. the Power Enable light goes out). Press Emergency Stop, release then press [CE] button.
Make a note of the figure on display.
To get off the extreme limit, hold down the Power Enable pushbutton while turning the handwheel.
iii) Deduct 0.4 mm from the noted display figure and enter the result in the Machine Parameter for the relevant axis.
i.e. Parameter 44 for the X axis
Parameter 46 for the Y axis
Parameter 48 for the Z axis
Deduct this entered figure from:
750.1 for the X axis
360.1 for the Y axis
150.1 for the Z axis and
enter the result as a negative value, in the second Machine Parameter for the relevant axis
i.e. Parameter 45 for the X axis
Parameter 47 for the Y axis
Parameter 49 for the Z axis.
iv) Using joystick, check that axis can be run on its software limits, in rapid and off again without operating the extreme limits

Check that the axis stroke between software limits is at least:
X = 750 mm
Y = 360 mm
Z = 150 mm
Record the new figures on the Machine Software Parameter Record which can be found in the door pocket of the electrical cabinet.

6.6 CONTROLLER BUFFER BATTERY REPLACEMENT

When the dialogue display reads EXCHANGE BUFFER BATTERY the batteries should be replaced by new ones as soon as possible. **Mains power MUST be maintained until this exchange is completed.** The programme memory is supplied by the mains power supply when the buffer batteries are discharged. Continued operation of the machine is therefore possible. However, the memory content will be erased in the event of a mains power failure.

CAUTION:
Batteries **must** be replaced with mains power supplied to the machine. Failure to observe this principle will result in a partial loss of the excecutive software.

The battery compartment which is located beneath the cover plate on the control panel, contains a special battery carrier. When inserting new batteries, care should be taken that the polarity conforms to the polarity signs shown on the carrier. The batteries to be used have IEC designation 'LRG' and must be of the leak-proof type. We especially recommend the use of Mallory Alkaline Batteries Type MN1500.

6.7 SPINDLE DRIVE UNIT SYSTEM DESCRIPTION

Power to the spindle motor is provided by a three phase fully controlled four quadrant thyristor converter unit. The converter unit consists of a THY–IR board (connected to the thyristors), a SOL 1 board (standstill and at speed detecter) and a FAC–IR board (main control board).

A seperate MTI board is provided to interface with the machine electronics and to control the spindle field.

The three phase main power input is connected to terminals L1, L2 and L3 and the motor armature output of 400 volts DC is connected to terminals A1 and A2 of the THY–IR card.

The motor field output of 270 volts DC is connected to terminals 34 and 35 of the MTI card.

The spindle motor has an integral tachometer providing velocity feedback to terminals 6 and 8 of the MTI card to control the motor between a speed range of 60 to 6,000 r.p.m.

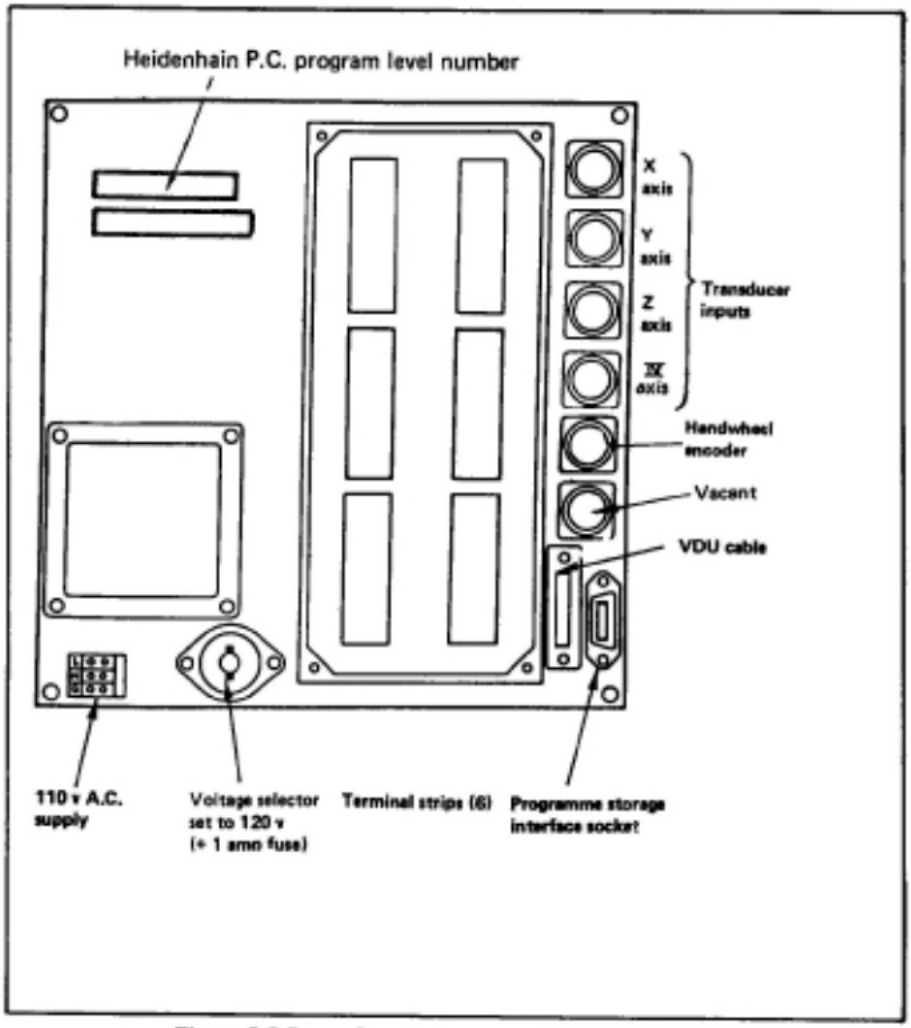


Figure 6.2 Rear of control system showing connections

A pulley ratio of 1.5:1 gives a spindle speed range of 40 to 4,000 r.p.m.

The TNC control unit outputs a 0 to ±10 volts DC signal between terminals J4/9 and J4/10 corresponding to a spindle speed and direction when the spindle commands M03 or M04 are programmed.

This signal is inputed to terminals 7 and 2 of the MTI board.

The TNC manual speed override potentiomenter can vary the spindle between 80% and 120% of the programmed value.

The following interlocks with the TNC control are provided by relays on the MTI card:
Relay RL4 (drive at speed) pulls in and relay RL5 (drive not at zero speed) drops out to provide a speed achieved signal to TNC terminal J5/7 to verify an M03 (M04) command.

Relay RL5 (drive at zero speed) pulls in to verify an M05 (spindle stop) command.
Relay RL3 (spindle drive is healthy) on dropping out will cause a proramme stop and/or a feed hold with the TNC controller.

6.8 REPLACEMENT OF SPINDLE DRIVE UNIT

Each drive unit is supplied by the manufacturers with all parameters preset (dynamic response, current limit, maximum speed etc). Only a final adjustment of spindle speed to suit individual motors is needed (see below).

6.8.1
Supply voltage

Before switching on machine check the main line voltage supply.

i) 380 to 460 volts, three phase, 50/60 Hz. Direct connection of spindle drive unit wires 200, 201, 202 to fuses MF4,5,6. CBI rating 32 amps.

ii) 200 to 240 volts, three phase, 50/60 Hz. Connect wires 200, 201, 202 to the spindle auto transformer output. Connect fuses MF4, 5, 6 to the auto transformer input, corresponding to supply voltage. CBI rating 50 amps.

6.8.2
Supply frequency

Check that both frequency selection links on the spindle drive FAC-1R card are set to 50/60 Hz as required.

6.8.3
Starting a Replacement Drive

i) Before starting the drive check the motor has been secured, the spindle drive belt properly tensioned (see section 8.1) and free to rotate.
Check all external electrical connections to the drive are correctly made.
Close main isolator and drive circuit breaker CBI. Confirm using multimeter that aux supply connections E1 and E2 on (SOL-1 card) have same phase relationship to supply L1 and L2. (NOTE phase rotation of L1 – L2 – L3 THY-IR CARD should be RED – YELLOW – BLUE as section 1).
Check the status of the following LEDS (Table 1) on the FAC-IR CARD (see figure 6.3).

ii) The spindle drive unit has a 10 position selector switch used as an on-board system monitor.
Check monitor positions 0 to 9.

iii) Turn both current limit pots fully counterclockwise (RV11 and RV12). Press CE and pass over reference points. Check 20CR and 26SC energise.

Check direction of 3 phase blower motor agrees with arrow on the blower body.

LED	LOCATION		
1	FAC–IR	OFF	
2	FAC–IR	OFF	
3	FAC–IR	ON	
4	FAC–IR	Sometimes glows dimly	
5 & 8	FAC–IR	ON	
207 TO 212	THY–IR	ON	Bridge 2 (M04)
6 & 7	FAC–IR	OFF	
201 TO 206	THY–IR	OFF	
5 & 8	FAC–IR	OFF	
207 TO 212	THY–IR	OFF	Bridge 1 (M03)
6 & 7	FAC–IR	ON	
201 TO 206	THY–IR	ON	
9	FAC–IR	ON	

NOTE On first switch on either bridge 1 or 2 will come on, either is acceptable as no M03, M04 has been programmed at this stage.

Monitor Position	Reading	Explanation
0	00	Monitor is properly zeroed (can be zeroed with RV10)
1	15±1	Factory preset +15v stabilized supply
2	–15±1	–15v stabilized supply (minus shown by –VE lamp)
3	26±2	+24v unstabilized supply
4	00	
5	00	
6	00	
7	00	
8	00	
9	00	

Director of Rotation	Tacho Polarity	Action
Correct	Correct	None
Correct	Wrong	Reverse tacho (terminals 6-8)
Wrong	Correct	Reverse 217 & 218 field & tacho
Wrong	Wrong	Reverse 217 & 218 field

Check LED 1 on MTI-1 card is on (ie. field healthy).
Check relay RL3 on MTI-1 card is energised.
Rotation direction and tacho polarity check.
Programme a spindle start M03 at 400 r.p.m. LED 1 or 2 on FAC-IR should come ON. Monitor Pos 4 should read +01 and monitor pos 9 should read –00.
Turn active current pot (RV12) slowly clockwise until spindle rotates. Check for correct direction of rotation. Check signal on position 9 is negative should go to –01 and hold steady as RV12 is rotated until fully clockwise. If either the direction of spindle rotation or the polarity of the tacho voltage is wrong, take the appropriate action as in table below.

Check motor speed is approx 600 r.p.m. by measuring tacho (item 6 and 8 FAC-IR) is approx 14 VDC.

Programme a spindle reversal M04 at 400 r.p.m. Turn current limit pot (RV11) fully clockwise while checking reverse motor speed. Tacho terms 6 and 8 FAC-IR still approximately 12 vDC.

Initiate M03 speed 1000 r.p.m. Set spindle override to 100%. Check that 'spindle off' button does not illuminate or switch off the spindle fan when pressed. Check that arm volts are approximately 220 volts D.C. Check field volts are approximately 150 volts D.C.

Increase speed in 1000 r.p.m. increments, check at each speed for normal running.
Confirm armature voltage (between terminals 215 and 216) is 395-400 volts at the maximum spindle speed of 4,000 r.p.m. Check field voltage is approx 30 volts between terminals 217 and 218.

Armature voltage can be adjusted using RV3 on MT1-1.

Check tacho voltage is approx 120 volts DC between terminals 6 and 8 on FAC-IR.

Repeat checks at 4000 r.p.m. in reverse (M04)

6.8.5
Speed adjustment
Programme a spindle speed M03 4000 r.p.m.

Measure spindle speed and adjust if necessary to achieve 4000 r.p.m. with control RV1 on FAC-IR. Programme a spindle reverse and check for speed balance between forward and reverse. If necessary speeds can be balanced using RV14 on FAC-IR followed by a final adjustment of RV1.
Repeat checks at 3000, 2000 and 1000 r.p.m. All achieved reading to be within ±5% of programmed speed.
Check at programmed speed of 40 r.p.m. achieved speed in forward and reverse is 40 r.p.m. ±2 r.p.m. If necessary adjust RV14.

6.8.6
Spindle drive interlocks
Programme a speed of 4000 r.p.m. Reverse spindle several times while checking cursor disappears after each reversal.

Programme a spindle stop M5.
Adjust RV3 on the SOL-1 card from fully CCW until LED 3 (SOL-1) just illuminates. Note RV3 setting programme a spindle start (M03 and M04) at 40 r.p.m. with spindle override set at 50%. Check LED 1 (FAC-IR) does not flicker. Check LED 3 goes out each time. Slowly increase setting of RV3 until LED 3 just illuminates. Reset RV3 in middle of settings.

With an axis in feed, press an emergency stop and check that it stops the axis and the spindle. Release the emergency stop and make sure that the spindle does not re-start or the feeds resume. Repeat this test with the other emergency stop.

Figure 6.3 Spindle drive unit layout

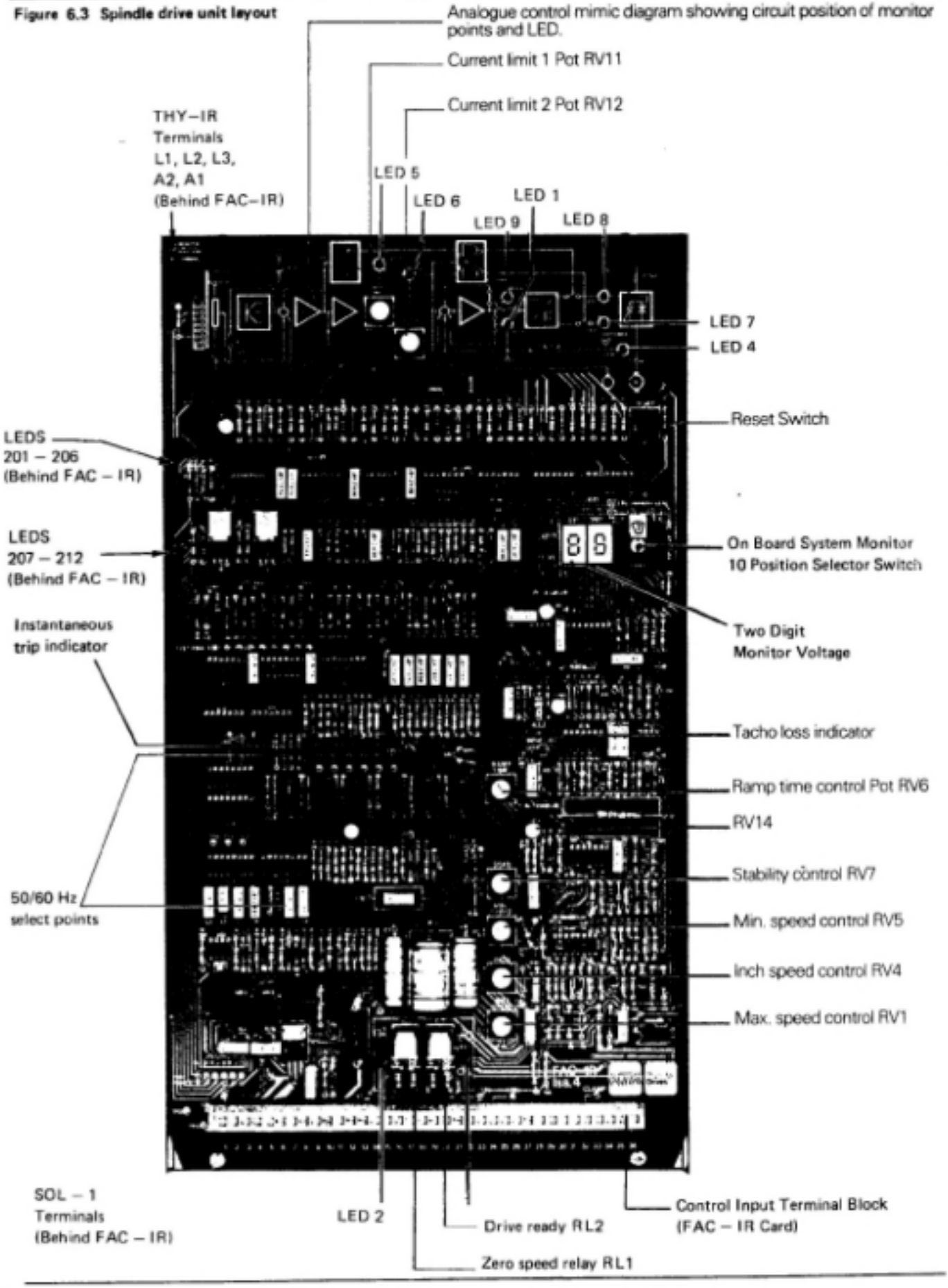


Table 1
LED status during transition from forward to reverse rotation. 1 indicates LED illuminated.

	LEDs on FAC-1R									LEDs on THY-1R	
Line No.	LED1	LED2	LED3	LED4	LED5	LED6	LED7	LED8	LED9	LEDS 201-6	LEDS 207-12
1	1	1	1	1	0	1	1	0	1	1	0
2	1	1	1	1	1	0	1	0	0	1	0
3	1	1	1	0	1	0	0	0	0	0	1
4	1	1	1	1	1	0	0	1	1	0	1

Table 2
Monitor position voltages as displayed by digital system monitor, with main isolator closed and DC contactor de-energised. Monitor position 0 indicates use of wander probe.

Monitor Position	Position on Circuit	Indicated DC Voltage (Volts)
1	+15v Power Supply	+15v ± 1v
2	−15v Power Supply	−15v ± 1v
3	+28v Power Supply	+26v ± 2v
4	Ramp Input	0v to ± 10v
5	Ramp Output	0v
6	Speed Amp Output	0v
7	Current Amp Output	0v
8	Current Feedback	0v
9	Speed Feedback	0v
0	TP1	0v
0	TP2	+6v ± 1v
0	TP3	+6v ± 1v
0	TP4	+6v ± 1v
0	TP5 to TP10	+3v ± 1v
0	TP11	+9v ± 1v
0	TP12	+14v ± 1v
0	TP13 to TP18	+24v ± 2v
0	TP19 to TP24	−1v ± 1v
0	TP25	+12v ± 1v

Table 3
LED status with main isolator closed, DC contactor energised but motor armature disconnected. Adjusting manual set potentiometer. 1 indicates LED illuminated.

	LEDs on FAC-1R									LEDs on THY-1R	
Set Speed Pot Position	LED1	LED2	LED3	LED4	LED5	LED6	LED7	LED8	LED9	LEDS 201-6	LEDS 207-12
Maximum forward speed demand	1	1	1	0	0	1	1	0	1	1	0
Maximum reverse speed demand	1	1	1	0	1	0	0	1	1	0	1

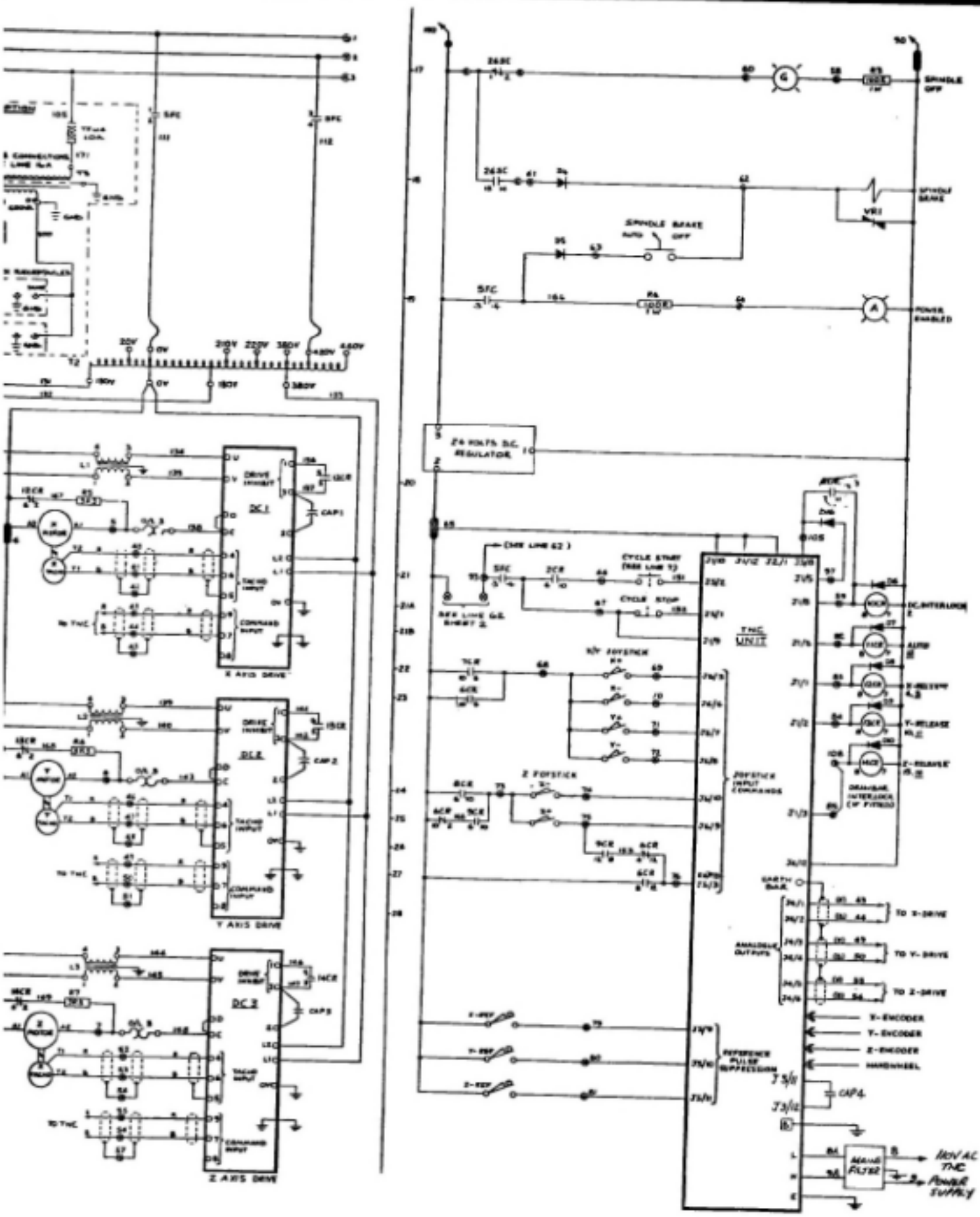
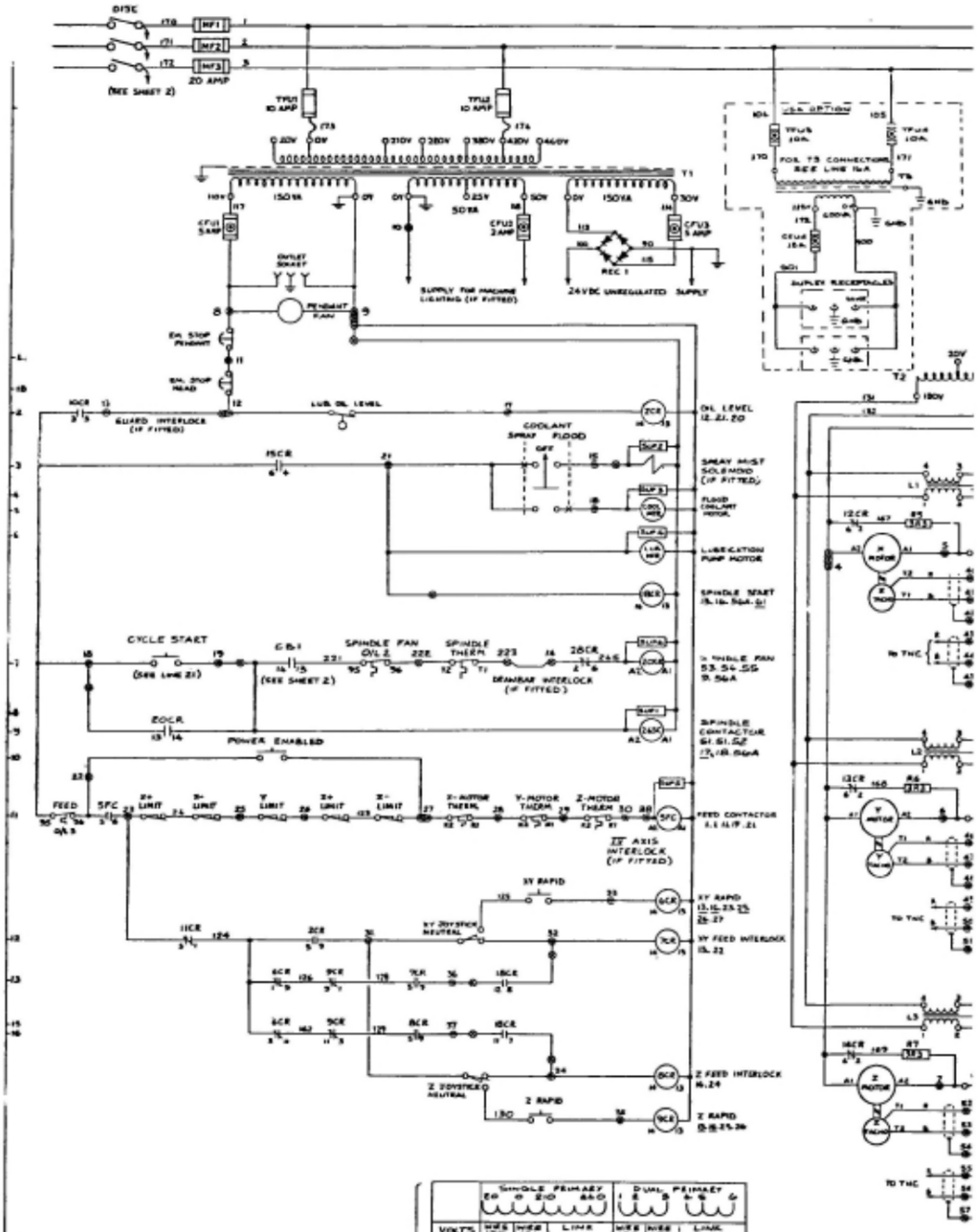


Figure 6-4 System wiring diagram drg. 215-264 Issue D (sheet 1 of 2)



ALTERNATIVE T3 CONNECTIONS

	SINGLE PRIMARY			DUAL PRIMARY		
	0 0 210 440			1 2 3 4 5 6		
VOLTS	WIRE 170	WIRE 171	LINK	WIRE 170	WIRE 171	LINK
208V	0	210	—	2	3	2-5/3-6
230V	20	210	—	1	3	1-4/3-6
460V	0	440	—	3	5	1-6
460V	20	440	—	3	4	1-6

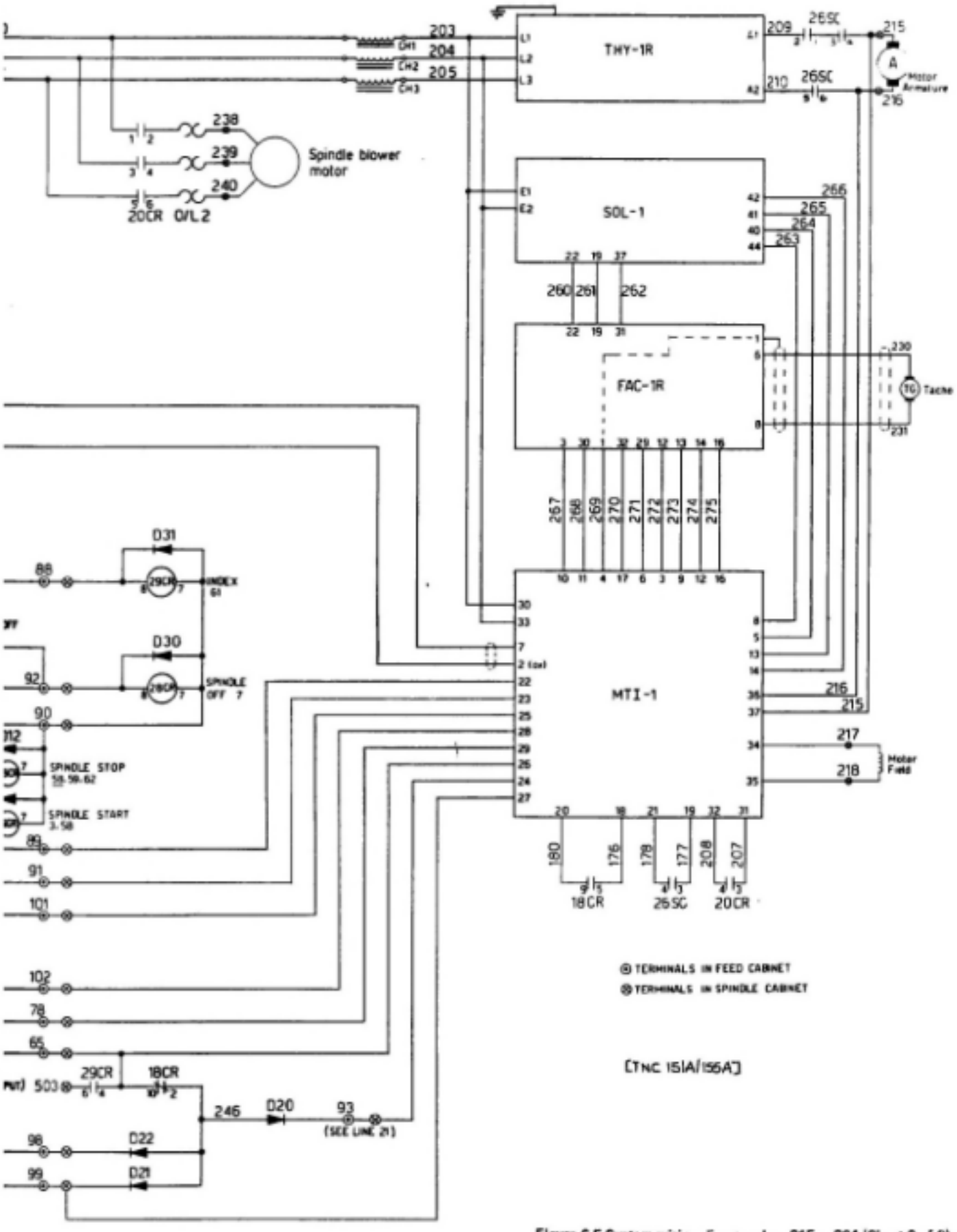
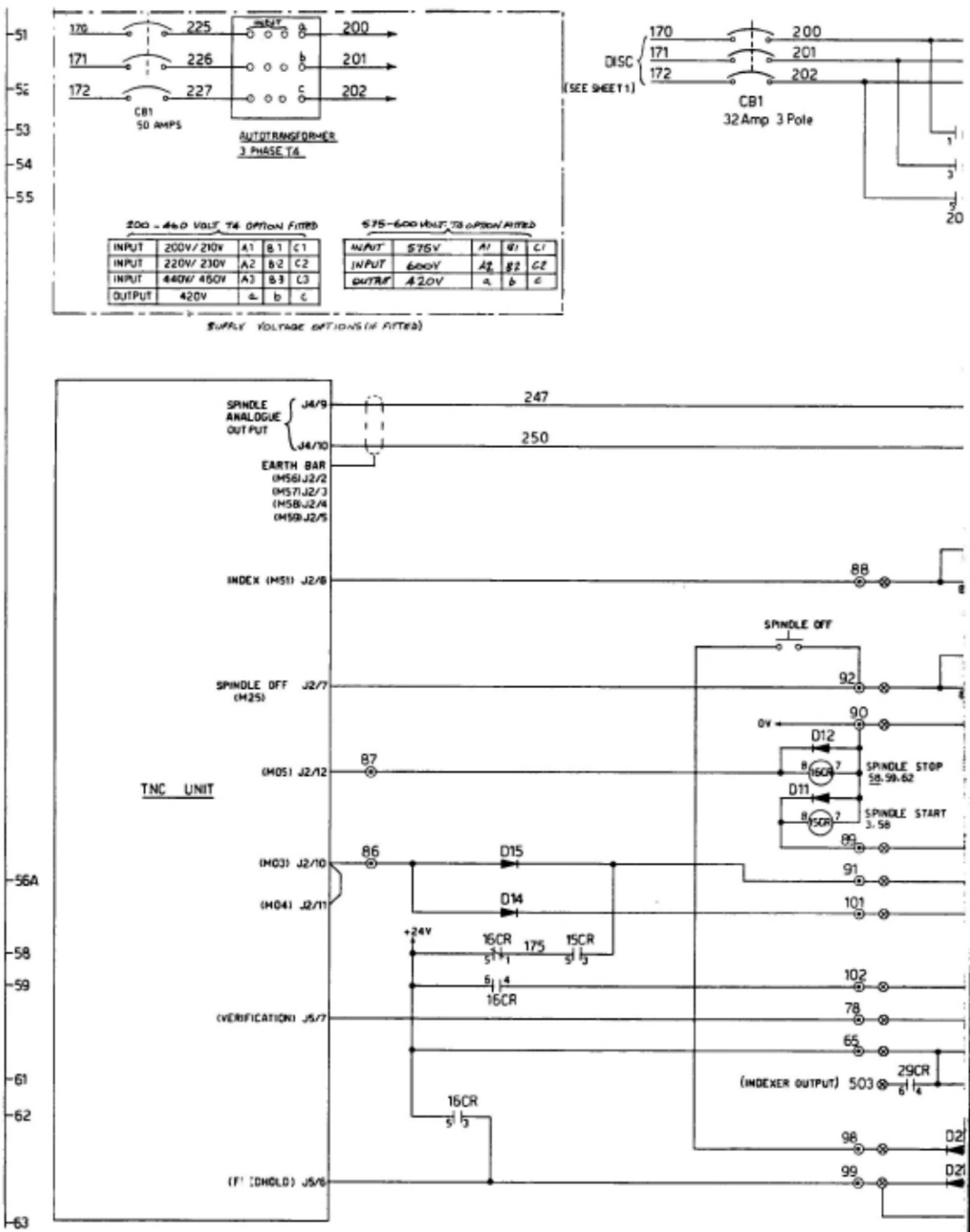
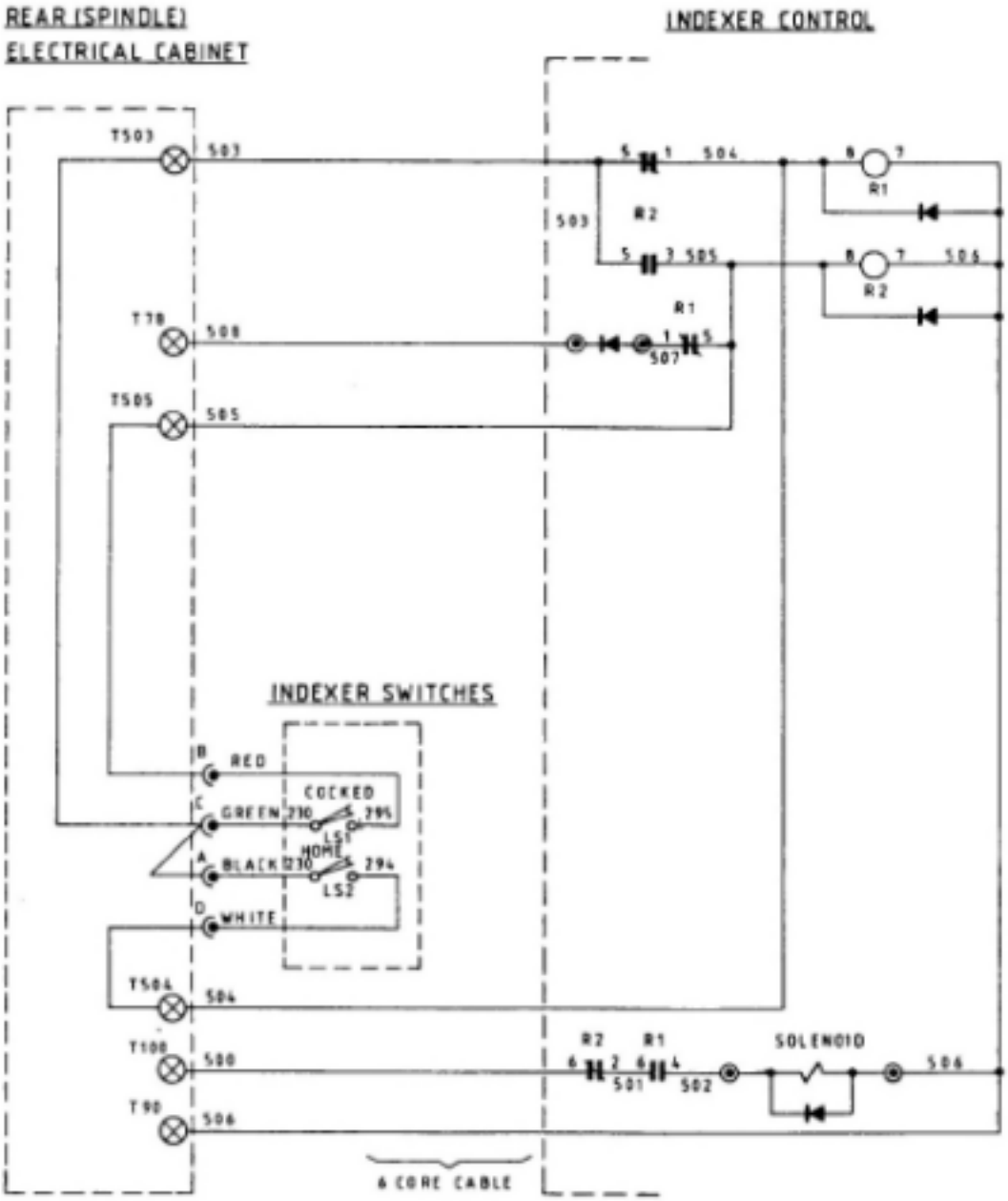


Figure 6-5 System wiring diagram drg. 215 – 264 (Sheet 2 of 2)


170
171
172
225
226
227
CB1
50 AMPS
INPUT
a
b
c
200
201
202
AUTOTRANSFORMER
3 PHASE T4
200 - 460 VOLT T4 OPTION FITTED
INPUT 200V/ 210V A1 B1 C1
INPUT 220V/ 230V A2 B2 C2
INPUT 440V/ 460V A3 B3 C3
OUTPUT 420V a b c
575-600 VOLT T3 OPTION FITTED
INPUT 575V A1 B1 C1
INPUT 600V A2 B2 C2
OUTPUT 420V a b c
SUPPLY VOLTAGE OPTIONS (IF FITTED)
(SEE SHEET 1)
DISC
170
171
172
200
201
202
CB1
32 Amp 3 Pole
1
3
5
20
51
52
53
54
55
SPINDLE ANALOGUE OUT PUT
J4/9
J4/10
247
250
EARTH BAR
(M56) J2/2
(M57) J2/3
(M58) J2/4
(M59) J2/5
INDEX (M51) J2/8
88
SPINDLE OFF
SPINDLE OFF J2/7
(M25)
92
0V
90
D12
87
(M05) J2/12
TNC UNIT
15CR
SPINDLE STOP
58.59.62
D11
SPINDLE START
3.58
89
86
D15
(M03) J2/10
(M04) J2/11
91
D14
101
56A
58
59
+24V
16CR
175
15CR
102
16CR
(VERIFICATION) J5/7
78
65
61
62
16CR
(INDEXER OUTPUT) 503
29CR
98
D2
(FEEDHOLD) J5/6
99
D21
63

WIRING DIAGRAM

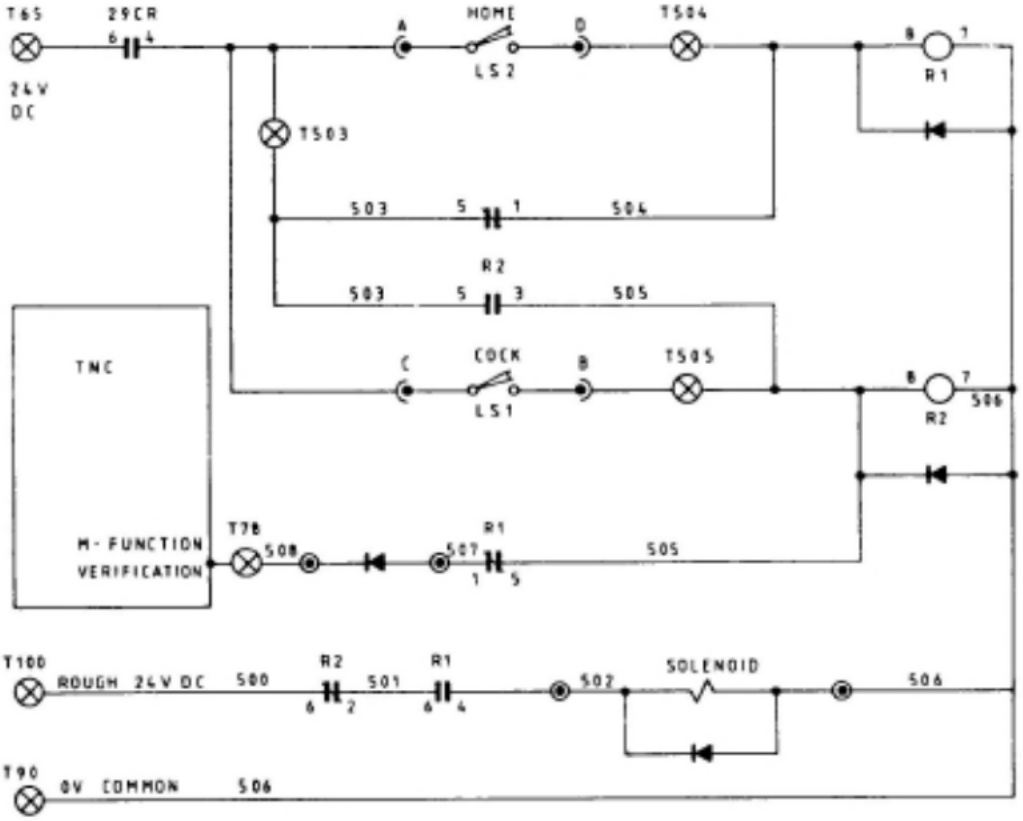


⊗ TERMINALS IN REAR SPINDLE CABINET

◉ TERMINALS IN INDEXER CONTROL

	QUANTITY		SCALE		DRAWN	EME	DATE	MARCH 85
SERIES II INTERACT 4-14 INDEXER OPTION-CIRCUIT & WIRING					PART No.		ISSUE - A	
					DRG. No.	215-214 SHT 2		

CIRCUIT DIAGRAM



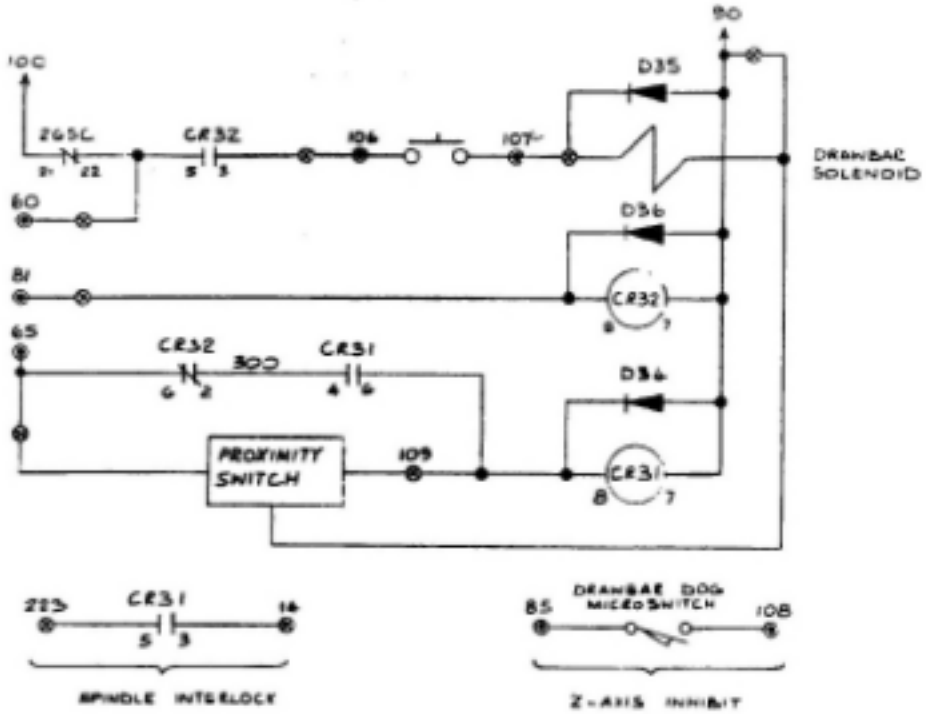
* ALL DIODES ARE IN4002 BRIDGEPORT PART No. 1555005

OPERATIONAL DESCRIPTION

WHEN AN M51 IS COMMANDED, 24V DC APPEARS AT TERMINAL J2/8 OF THE TNC CONTROL UNIT. THIS ENERGISES RELAY 29 CR IN THE SPINDLE DRIVE CABINET WHICH ENERGISES RELAY R1 AT THE INDEXER MANIFOLD. THE SOLENOID IS ENERGISED MAKING THE INDEXER COCK. LS2 IS CLOSED AS IT LEAVES THE HOME POSITION AND LS1 IS CLOSED WHEN THE FULLY COCKED POSITION IS REACHED. THIS SWITCHES R2 ON AND DE-ENERGISES THE SOLENOID ALLOWING INDEXING. AFTER LEAVING THE COCKED POSITION LS1 OPENS AND WHEN HOME, LS2 OPENS. R1 DROPS OUT ALLOWING THE 24V DC SIGNAL TO THE VERIFICATION INPUT CANCELLING THE 24V DC SIGNAL AT J2/8 AND ALLOWING THE PROGRAMME TO CONTINUE.

	QUANTITY		SCALE		DRAWN	EME	DATE	MARCH 85
SERIES II INTERACT 4 - I4 INDEXER OPTION - CIRCUIT & WIRING					PART No.		ISSUE - A	
					DRG. No.	215 - 214 SHT 1		

CIRCUIT DIAGRAM



SETTING UP INSTRUCTIONS

① REMOVE DRAWBAR RELAY CR31
ENTER Z HANDWIND MODE & ENTER REFERENCE MODE
HANDWIND QUILL TO ZERO. CHECK SPINDLE OFF LAMP IS ALIGHT.
CHECK THE TOOLS INSERT & RELEASE O.K. ✓
CHECK DRAWBAR DOG MICROSWITCH IS CLOSED WHEN DRAWBAR IS NOT OPERATED AND OPENS BEFORE THE DOG ENGAGES THE PULLEY WHEN THE DRAWBAR IS OPERATED

② WIND BELOW REFERENCE SWITCH. CHECK THE DRAWBAR BUTTON IS INOPERATIVE
WIND BACK SLOWLY UNTIL THE REFERENCE SWITCH JUST MAKES CHECK THE TOOL CAN BE INSERTED AND RELEASED PROPERLY

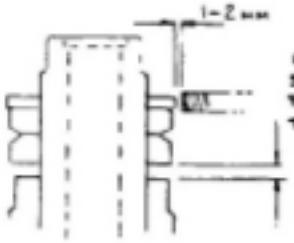
③ WITH THE Z AXIS ABOVE ITS REFERENCE SWITCH, ADJUST THE GAP BETWEEN THE PROXIMITY DETECTOR & THE DRAWBAR DISC AT 1 – 2 mm

④ HANDWIND QUILL TO ZERO. ENGAGE A TOOL. ADJUST PROXIMITY SWITCH ASSEMBLY UPWARDS UNTIL THE LED GOES OUT. ADJUST DOWNWARDS UNTIL LED JUST COMES ON.
ADJUST DOWNWARDS ONE MORE TURN

⑤ INCORRECTLY ENGAGE A TOOL AND CHECK THE LED DOES NOT LIGHT.

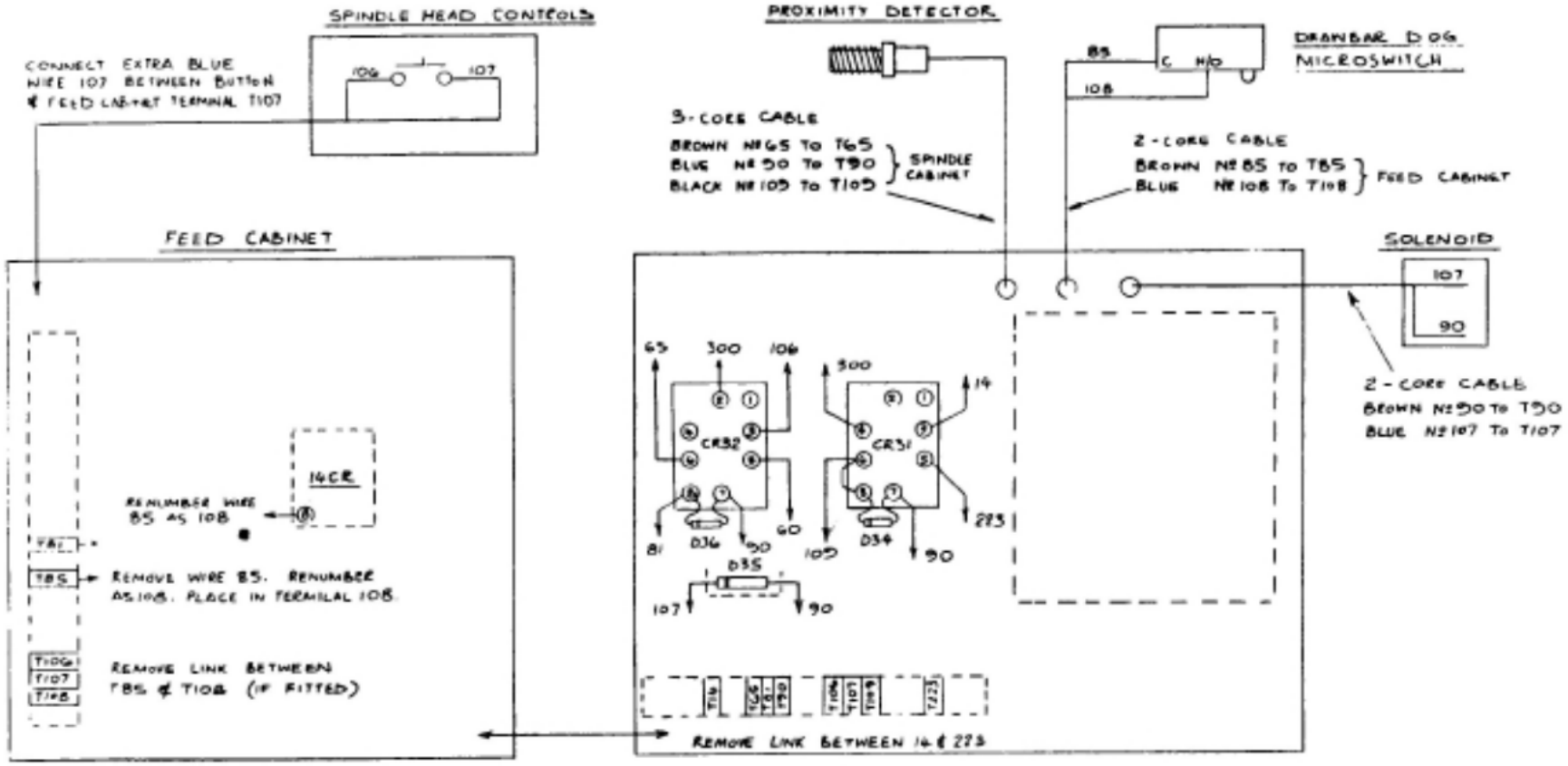
⑥ HANDWIND BELOW REFERENCE SWITCH. HANDWIND UP AND CHECK THE PROXIMITY SWITCH VERTICAL ROD STARTS TO RISE BEFORE THE REFERENCE SWITCH OPERATES
AFTER ANY NECESSARY ADJUSTMENT, REPEAT STEPS ④, ⑤ AND ⑥ REPLACE RELAY CR31

⑦ CHECK THE SPINDLE WILL START WITH THE TOOL ENGAGED OR RELEASED.
CHECK THE DRAWBAR BUTTON IS INOPERATIVE WHEN THE SPINDLE IS RUNNING.
CHECK THE SPINDLE WILL NOT START WITH A TOOL INCORRECTLY ENGAGED



WITH A TOOL ENGAGED, THIS DIMENSION SHOWN MUST BE 5mm (APPROX) BETWEEN THE BOTTOM LOCKNUT AND THE TOP OF THE BUSH.

MATERIAL	–	QUANTITY	–	SCALE	–	DRAWN	G.BLAIR	DATE	DEC. 83
PART	POWER DRAWBAR OPTION					PART No.			
MACHINE	SERIES II INTERACT 4					DRG. No.	215-211 ISSUE D		



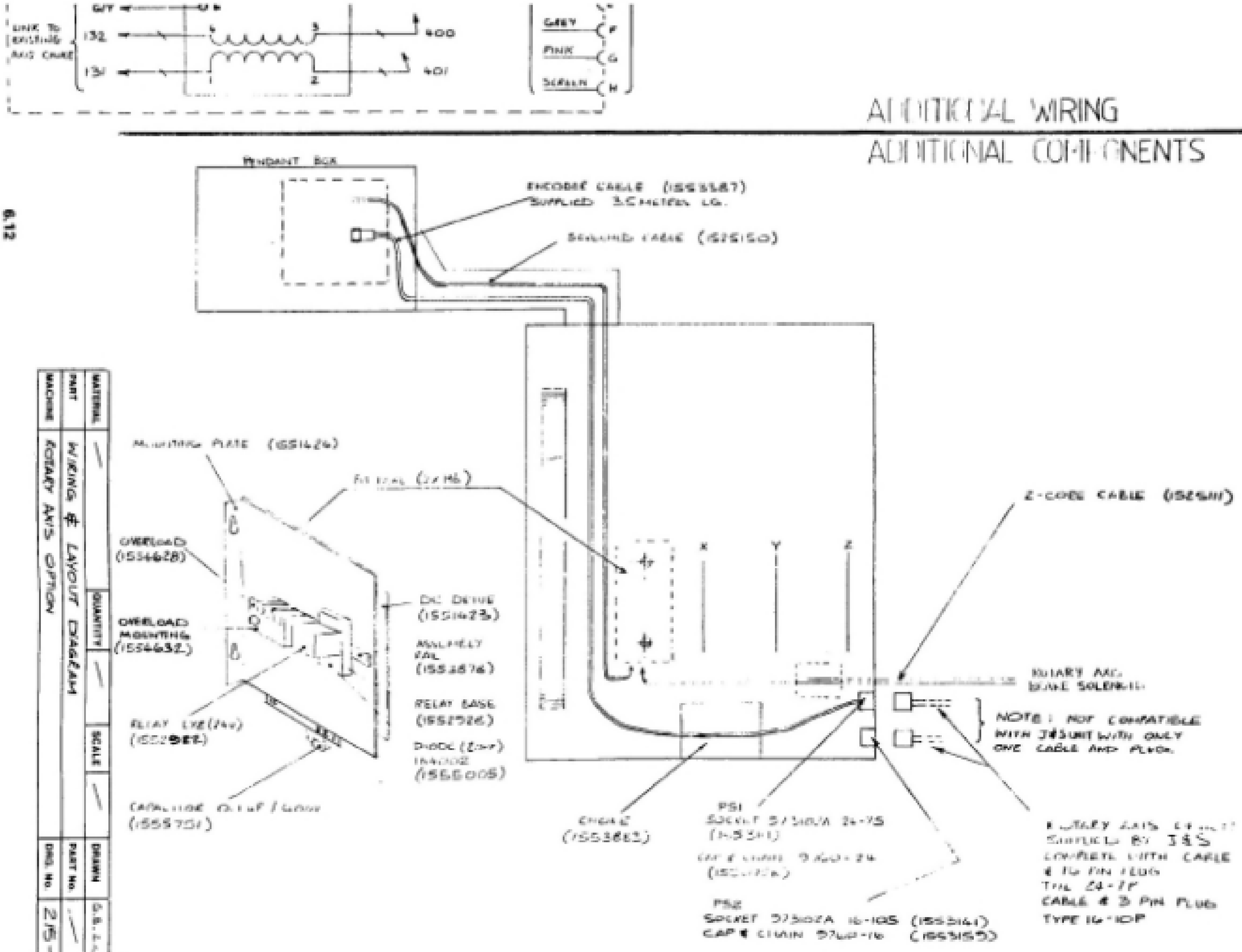
CONNECT EXTRA WIRES 106 & 107 BETWEEN TERMINALS 106 & 107 IN THE FEED CABINET & TERMINALS 106 & 107 IN THE SPINDLE CABINET. (IF REQUIRED)

SPINDLE CABINET WIRING

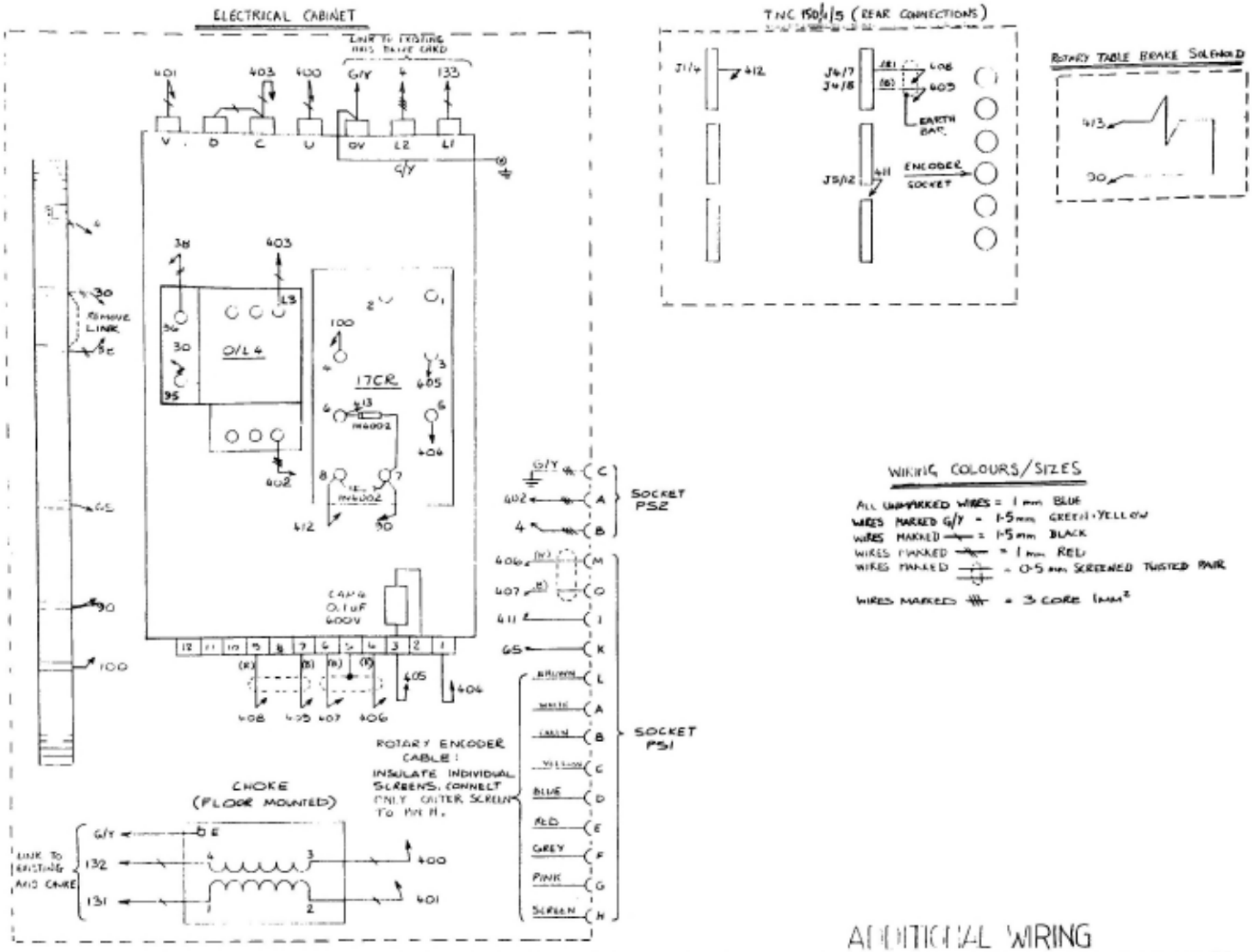
WIRE Nº	TYPE	FROM	TO	TO	TO
223	1mm RED	CR31/5	T223		
14	—"—	CR31/3	T14		
60	1mm BLUE	Z65C/22	CR32/5		
65	—"—	CR32/6	T65		
81	—"—	CR32/8	D36(+)	T81	
90	—"—	CR31/7	D34(-)	CR32/7	D36(-)
			D35(-)	T90	
106	—"—	CR32/3	T106		
107	—"—	D35(+)	T107		
109	—"—	CR31/8	D34(+)	CR31/6	T105
300	—"—	CR31/4	CR32/2		

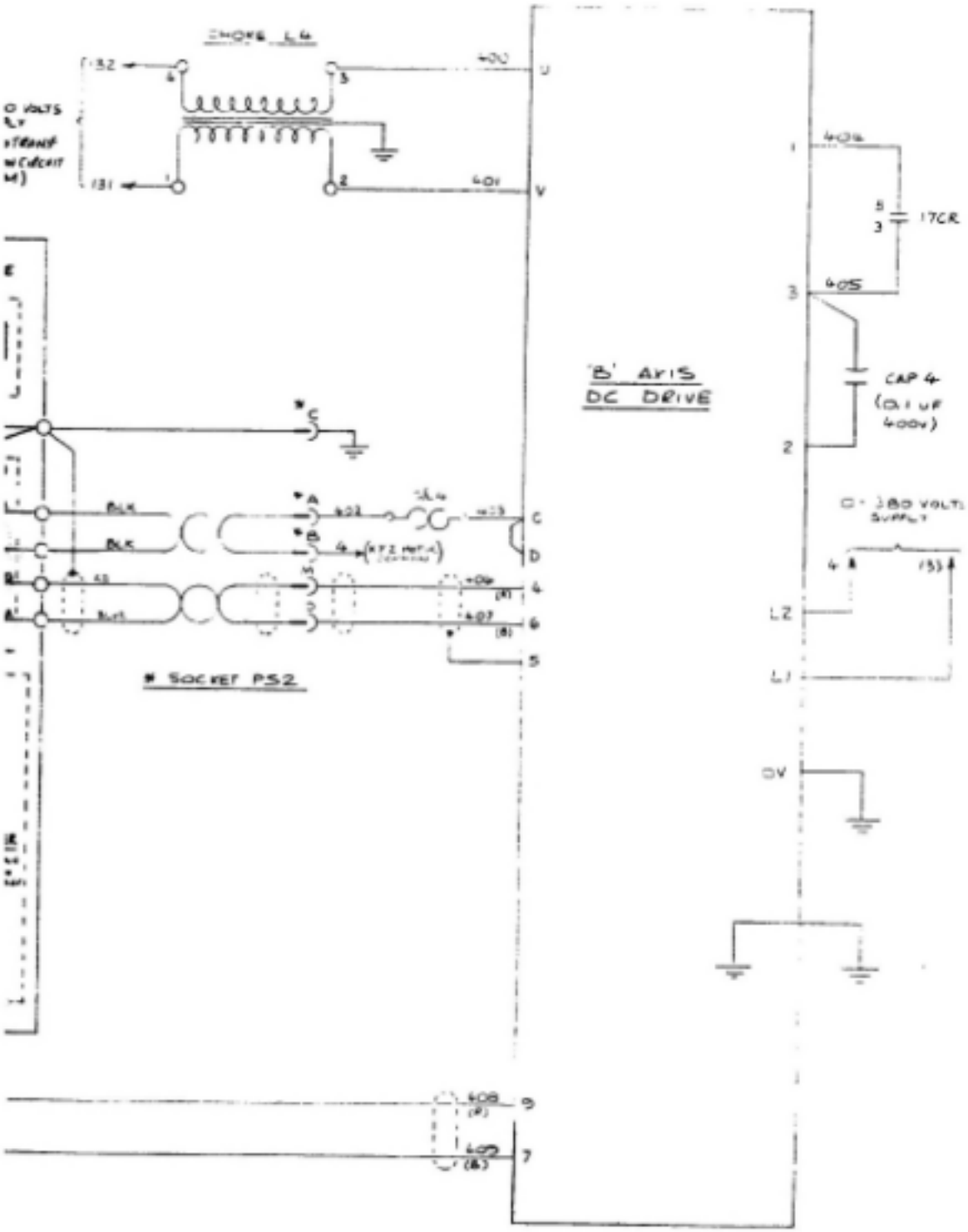
ADDITIONAL WIRING

ADDITIONAL COMPONENTS

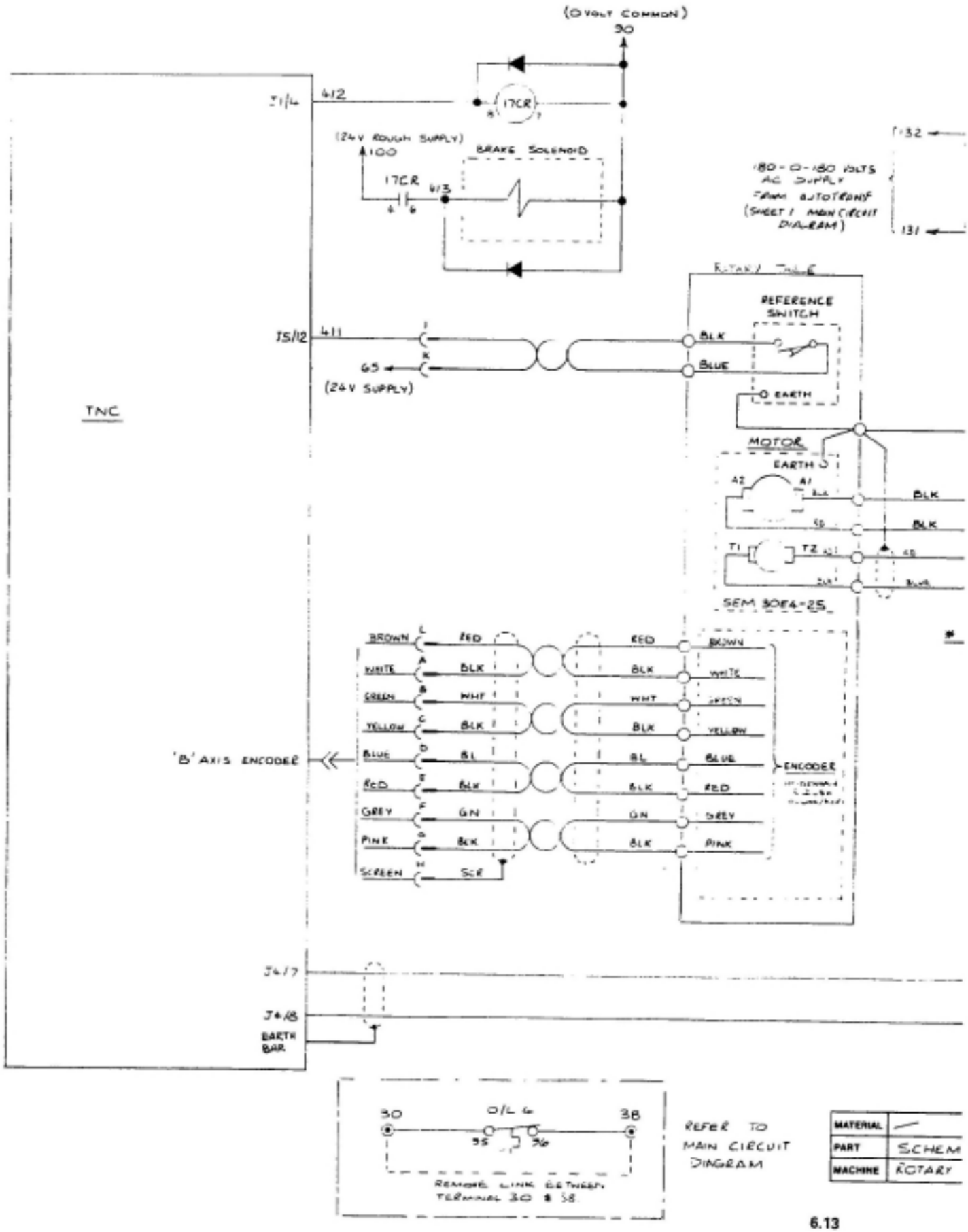


MATERIAL	—	QUANTITY	—	SCALE	—	DRAWN	G.B.L.L.	DATE	4/84
PART	WIRING & LAYOUT DIAGRAM					PART No.	— Sht 1 of 2		
MACHINE	ROTARY AXIS OPTION					DRG. No.	215-261 Issue [illegible]		


ELECTRICAL CABINET
LINK TO EXISTING AXIS DRIVE CARD
401
403
400
G/Y
4
133
V
D
C
U
0V
L2
L1
G/Y
38
403
30
REMOVE LINK
36
30
35
L3
O/L 4
100
17CR
405
IN4002
404
402
412
50
65
90
100
CAP 4
0.1uF
400V
12
11
10
9
8
7
6
5
4
3
2
1
408
405
407
406
405
404
CHOKE
(FLOOR MOUNTED)
LINK TO EXISTING AXIS CABLE
G/Y
132
131
400
401
ROTARY ENCODER CABLE:
INSULATE INDIVIDUAL SCREENS. CONNECT ONLY OUTER SCREEN TO PIN H.
G/Y
402
4
SOCKET PS2
406
407
411
65
BROWN
WHITE
GREEN
YELLOW
BLUE
RED
GREY
PINK
SCREEN
SOCKET PS1
TNC 150/155 (REAR CONNECTIONS)
J1/4
412
J6/7
J6/8
408
405
EARTH BAR
J5/12
411
ENCODER SOCKET
ROTARY TABLE BRAKE SOLENOID
413
30
WIRING COLOURS/SIZES
ALL UNMARKED WIRES = 1 mm BLUE
WIRES MARKED G/Y = 1·5 mm GREEN/YELLOW
WIRES MARKED = 1·5 mm BLACK
WIRES MARKED = 1 mm RED
WIRES MARKED = 0·5 mm SCREENED TWISTED PAIR
WIRES MARKED = 3 CORE 1mm²
ADDITIONAL WIRING



MATERIAL	—	QUANTITY	—	SCALE	—	DRAWN	G. BLAKE	DATE	4/84
PART	SCHEMATIC DIAGRAM					PART No.	SHT 2 OF 2		
MACHINE	ROTARY AXIS OPTION					DRG. No.	215-261	ISSUE	4


(0 VOLT COMMON)
30
7/4
412
17CR
(24V ROUGH SUPPLY)
100
BRAKE SOLENOID
17CR
6/3
4
6
180-0-180 VOLTS
AC SUPPLY
FROM AUTOTRONIC
(SHEET 1 MAIN CIRCUIT
DIAGRAM)
132
131
ROTARY TABLE
REFERENCE
SWITCH
15/12
411
65
(24V SUPPLY)
BLK
BLUE
0 EARTH
TNC
MOTOR
EARTH
A2
A1
BLK
BLK
S2
T1
T2
SEM 50E4-25
'B' AXIS ENCODER
BROWN
RED
WHITE
BLK
GREEN
WHT
YELLOW
BLK
BLUE
BL
RED
BLK
GREY
GN
PINK
BLK
SCREEN
SCR
ENCODER
J4/7
J4/8
EARTH
BAR
30
O/L 6
38
35
36
REMOVE LINK BETWEEN
TERMINAL 30 & 38
REFER TO
MAIN CIRCUIT
DIAGRAM
MATERIAL
PART
SCHEM
MACHINE
ROTARY

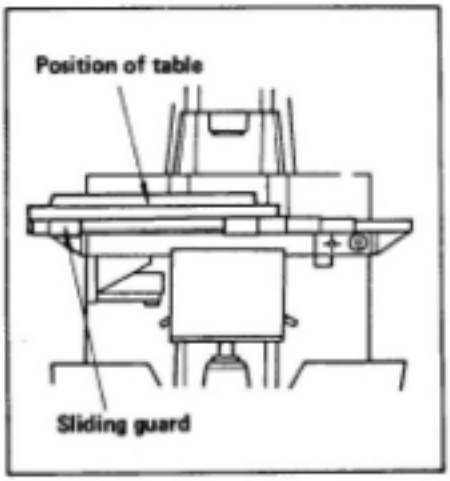
7. BASE ASSEMBLY AND MAINTENANCE

7.1 DRIVE BELT REPLACEMENT

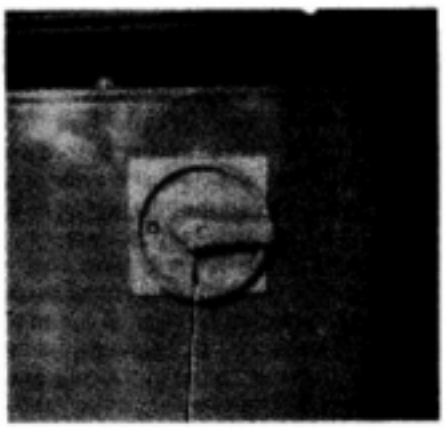
7.1.1
X axis belt replacement
To make the task of re-assembly easier the table needs to be towards the left hand end of its stroke. Depending upon whether the belt is broken or not determines the sequence in which the job is done.

If the belt is not broken:

i) Traverse the machine to the left hand end.



WARNING:
Disconnect power to the machine by throwing the main circuit breaker to the **OFF** position.



Isolator in OFF position

ii) Remove the eight screws securing the left hand end table sliding guard and remove. It may be necessary to remove the fixing screws of the lubrication junction on the rear of the table. Do not disturb the lubrication fittings.

iii) Remove the two screws securing the motor bracket cover and remove the cover.

iv) Remove the four screws securing the saddle end cover and remove the cover.(see:If the belt is broken paragraph 4).

Motor bracket cover **Saddle end cover**

Lubrication junction

If the belt is broken:

WARNING:
Disconnect power to the machine by throwing the main circuit breaker to the **OFF** position.

Isolator in OFF position

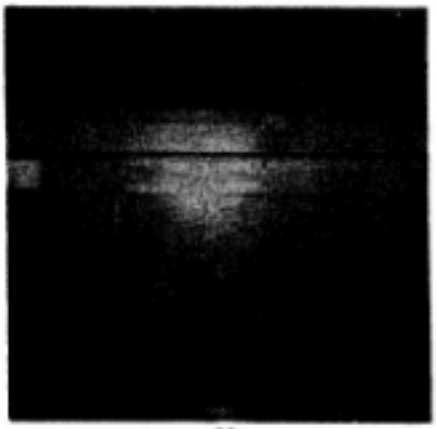
i) Remove the eight screws securing the left hand end table sliding guard and remove. It may be necessary to remove the fixing screw of the lubrication junction on the rear of the table. Do not disturb the lubrication fitings.

ii) Remove the two screws securing the motor bracket cover and remove the cover.

iii) Remove the four screws securing the saddle end cover and remove the cover. This gives access to the leadscrew and the driven pulley. Rotate the leadscrew manually to bring the table to the left hand end.

iv) Remove two screws securing motor cover and remove cover.

v) Support the motor and remove the four screws securing the motor and remove the motor.



Belt **Motor**

vi) Remove the old belt and refit the new belt on the driven pulley.

vii) Refit the motor, inclining the motor to re-engage the drive pulley. Refit the four securing screws.

viii) Adjust the belt tension so it is tensioned by a force of approximately 135 N (30 lbf). If no belt tension meter is available an approximate guide is that at mid position between the pulleys the belt will deflect 6 mm (1/4") from its mean position when a force of 70 N (16 lbf) is exerted on the belt.

ix) Reset the machine software limits as per Section 7.6.3.

7.1.2
Y axis drive belt replacement
To ensure that no damage occurs to the Y axis ballscrew during this procedure, two people are required, one to withdraw the knee front bracket and maintain the alignment of the assembly, whilst the second person slips the old belt from the pulley and over the end of the leadscrew and replaces it with a new one.

WARNING:
Disconnect power to the machine by throwing the main circuit breaker to the **OFF** position.

Isolator in OFF position

i) Remove the two neoprene covers on the top of the knee.
ii) Remove the stop pin on knee front bracket and slide covers forward.

Stop pin

iii) Remove the T inspection plate at the rear of the top of the knee.

T inspection plate

iv) Remove the access hole cover on the left hand side of the knee.

Cover **Tension screw**

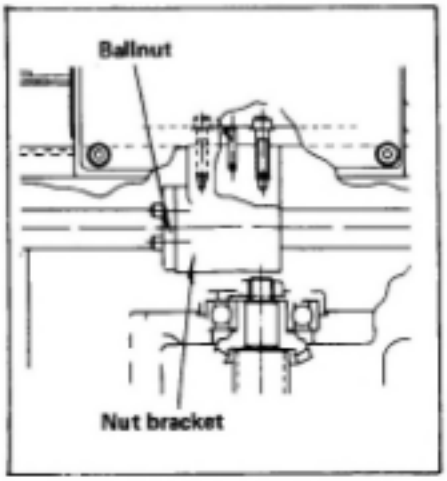
Motor cover

v) Remove the motor bracket cover.
vi) Remove the motor cover.
vii) Slacken the belt tension screw on the motor bracket above the motor flange.
viii) Support the motor and remove the four screws securing the motor and remove the motor. The dowel pin, underneath the tension screw, will be released so make sure this item is located.
ix) Remove the two fixing screws from the top corners of the knee front bracket and replace with two screws 5/16 UNC x 5" long. These new screws will allow the front bracket, complete with the Y axis ballscrew to be slid forward to give clearance to remove the drive belt.
x) From the access hole in the knee remove the formed copper lubrication pipe from the top of the ballnut. Remove the four screws securing the ballnut from its nut bracket.

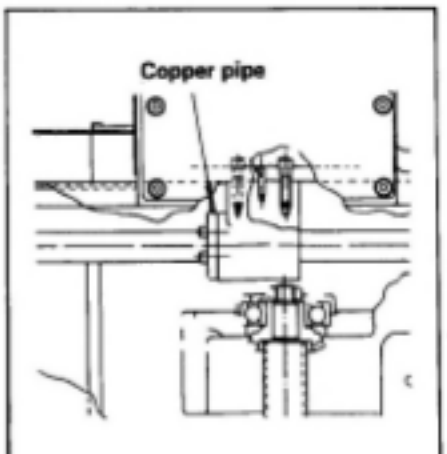
Dowels

xi) Withdraw the front bracket dowels and remaining fixing screws and carefully pull forward the front bracket complete with the ballscrew assembly. The second person should guide the rear of the leadscrew to maintain its position and avoid damage.
xii) The old belt can now be slipped off the pulley and clear of the rear of the leadscrew. Fit the new belt on the leadscrew pulley and relocate the leadscrew in its rear bearing. This bearing is a shell needle roller bearing and care must be taken to ensure no damage occurs to the needle bearing or the return tubes of the ballscrew assembly. Ensure the copper lubrication pipe is not trapped.
xiii) Realign the ballnut and loosely fit the four screws.
xiv) Refit the screws and dowels securing the front bracket.

xv) Rotate the leadscrew anti-clockwise to bring the face of the ballnut hard in contact with the nut bracket.



xvi) Tighten the four screws in the nut bracket to a torque of 9 Nm (80 lbin) and refit the copper pipe into the top of the ballnut flange.



xvii) Refit the motor, inclining to engage the motor pulley in the belt and fit the four fixing screws, ensuring that the belt tension screw and pin are correctly fitted.

xviii) Adjust the belt tension so it is tensioned by a force of 135 N (30 lbf). If no belt tension meter is available an approximate guide is that at the mid point between the pulleys the belt will deflect 6 mm (1/4") from its mean position when a force of 70 N (16 lbf) is exerted on the belt.

xix) Reset the machine software limits per Section 7.6.7.

7.2 X AND Y AXIS DRIVE MOTOR REPLACEMENT

7.2.1 X axis drive motor replacement

WARNING:
Disconnect power to the machine by throwing the main circuit breaker to the **OFF** position before begining this procedure.

Isolator in OFF position

i) Remove the two screws securing the motor bracket cover and remove the cover.

ii) Support the motor and remove the four screws securing the motor and remove the motor.

4 securing screws

iii) Remove rear cover from pendant box and the cover plates from the external cable exit of the pendant arm.

iv) Remove the cable ties from the X axis resolver cable and unwrap the spiroband sleeve.

Spiroband sleeve

v) Disconnect the X axis resolver cable from the rear of the Heidenhain unit and pull the cable out of the pendant arm.

vi) Disconnect the motor wiring to the motor at the terminal box.

Terminal box

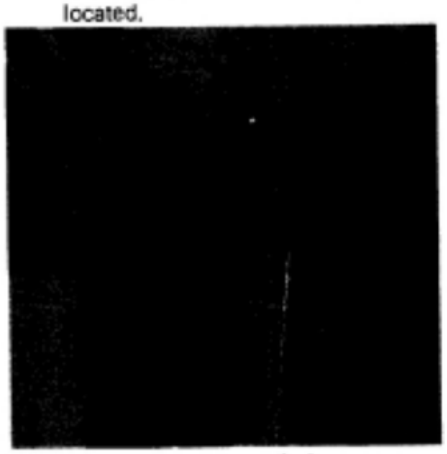
vii) Remove the drive pulley and fit to the new motor.
viii) Install replacement motor by reversing steps (iii) to (vi) above.
ix) After the motor is installed, set the belt tension as described in Section 7.1.1 item (viii). Check the reference limit as per Section 7.6.2 and reset the software limits as per Section 7.6.3.

7.2.2
Y axis drive motor replacement

WARNING:
Disconnect power to the machine by throwing the main circuit breaker to the **OFF** position before beginning this procedure.

Isolator in OFF position

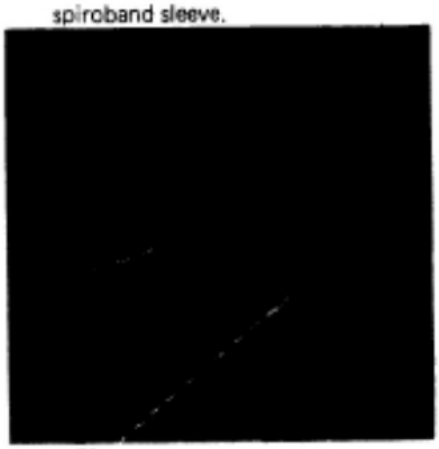
i) Remove the two screws securing the motor bracket cover and remove the cover.
ii) Slacken the belt tension screw on the motor bracket above the motor flange.
iii) Support the motor and remove the four screws securing the motor and remove the motor. The dowel pin underneath the tension screw will be released, so make sure this item is located.



Dowel pin

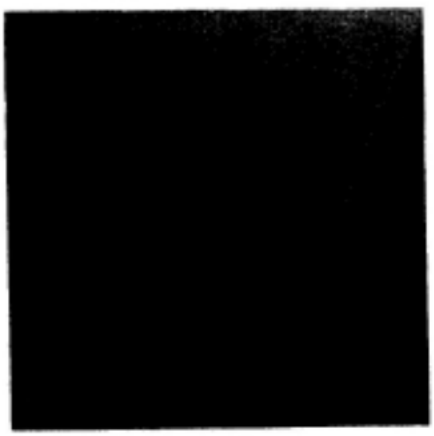
iv) Remove rear cover from pendant box and the cover plates from the external cable exit of the pendant arm.

v) Remove the cable ties from the Y axis resolver cable and unwrap the spiroband sleeve.



Sleeve

vi) Disconnect the Y axis resolver cable from the rear of the Heidenhain unit and pull the cable out of the pendant arm.
vii) Disconnect the motor wiring to the motor at the terminal box.



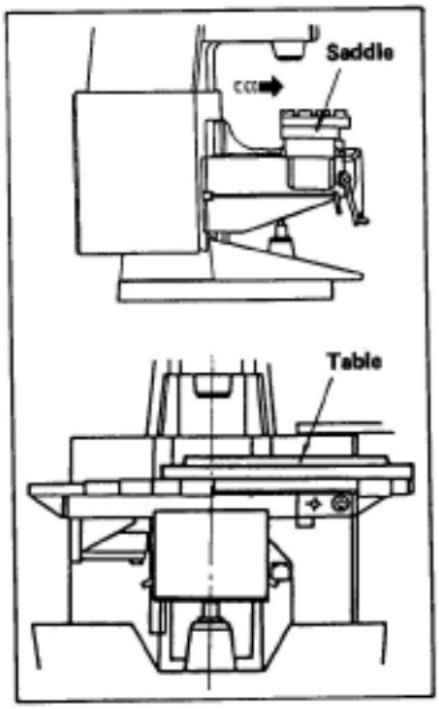
Terminal box

viii) Remove the drive pulley and fit to the new motor.
ix) Install new motor.
x) After the motor is installed, set the belt tension as described in Section 7.1.2 item (viii). Check the reference limit as per Section 7.6.6 and reset the software limits as per Section 7.6.7.

7.3 TABLE AND SADDLE REMOVAL

7.3.1
Table removal

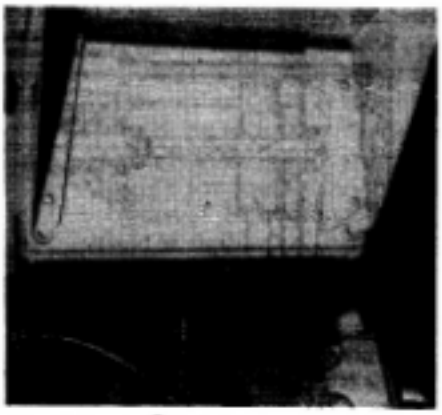
i) Move the saddle well forward and the table to the right side of the machine.



ii) Disconnect power to the machine by throwing the main circuit breaker to the **OFF** position.

Isolator in OFF position

iii) Remove the six screws and remove the cover from the right hand underside of the saddle.



Cover

iv) Remove four screws securing the ball nut to the nut bracket.

v) Ease off copper lubrication pipe from the top of the ballnut and leave clear on one side.

Lubrication oil pipe

vi) Remove the eight screws securing each table end sliding guard and remove the guards. Disconnect the lubrication line from the saddle. It may also be necessary to remove the fixing screws of the lubrication junction on the rear of the table to release the right hand sliding guard.

vii) Remove the four screws securing the right hand end saddle cover and remove cover.

End cover

viii) Remove the taper gib and table hold down keep strips. Ensure these strips are returned to their original positions on re-assembly.

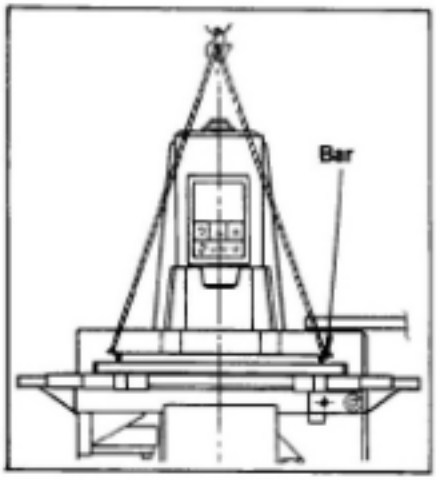
Taper gib strip

ix) Remove the coolant return tubes from the table.

Lubrication junction

x) Place suitable bars in each end of the table centre tee slot and rope sling around these bars with a central lift point.

CAUTION:
The table weighs 315 kg (694 lb). Use appropriate care to prevent equipment damage and personal injury.



xi) Depending upon the position of the saddle, it may help the rope position to open the front switch door on the head and swing clear of the rope.

xii) When lifting the table take extreme care not to bump the table on the saddle slideways and cause damage to the chrome.

7.3.2
Saddle removal

i) Remove the table as specified in Section 7.3.1.

ii) Remove two screws securing the motor bracket cover and remove the cover.

iii) Remove the four screws securing the left hand saddle end cover and remove the cover.

End cover **Securing screws**

iv) Support the X axis drive motor and remove the four screws securing the motor and remove the motor. Place the motor safely on the floor and protect it from damage.

v) Remove chip wipers and taper strip.
vi) Remove hold down keep plates. Ensure these strips are returned to their original positions on re-assembly.
vii) Remove ballscrews as described in Section 7.4.2.
viii) Remove limit switches as described in Section 7.6.4.

Chip wipers **Keep plate**

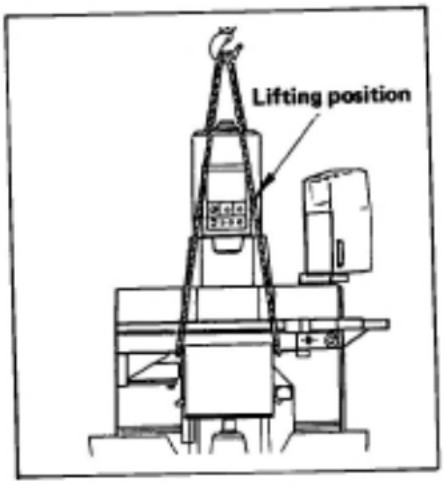
ix) Remove the access hole cover on the left hand side of the knee.
x) From the access hole remove the formed copper lubrication pipe from the top of the ballnut. Remove the four screws securing the ballnut from its nut bracket.

Access hole cover

xi) Place a suitable rope sling around each end of the saddle with a central lift.

CAUTION:
The saddle weighs 213 kg (470 lb). Use appropriate care to prevent equipment damage and personal injury.

xii) When lifting the saddle take extreme care not to bump the table on the knee slideway and cause damage to the chrome.



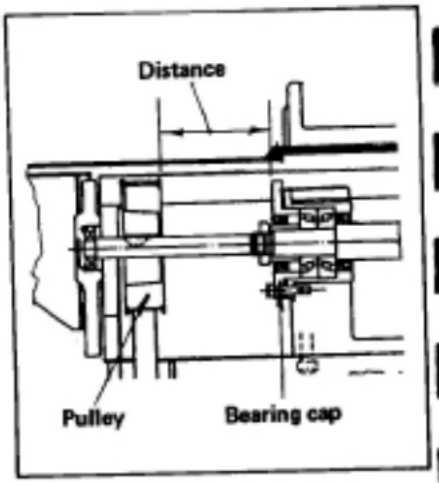
7.4 X AND Y AXIS BALLSCREW

7.4.1
X axis ballscrew assembly removal

i) Remove the table as specified in Section 7.3.1.
ii) Remove two screws securing the motor bracket cover and remove the cover.
iii) Remove the four screws securing the left hand saddle end cover and remove the cover.

End cover

iv) Support the X axis drive motor and remove the four screws securing the motor and remove the motor. Place the motor safely on the floor and protect it from damage.
v) Measure and record the distance from the drive pulley to the bearing cap, this being done so the driven pulley can be re-assembled in its original position to line up with the motor pulley.
vi) Release the taper lock and remove the pulley and taper lock.



vii) Remove the five screws securing the thrust bearing cap and bearing assembly. The ballscrew assembly can now be withdrawn from the left hand end of the saddle. Remove the bearings from the ballscrew.
viii) To replace a new ballscrew, reverse the disassembly procedure, paying particular attention to the following:
a) The ballscrew assembly is supplied from the original manufacturer protected in lanolin, and this **must** be completely removed. Wash the assembly by completely immersing in **CLEAN** white spirit **(NOT PARAFFIN)** and brushing well. Run the ballnut up the full length of the screw to ensure complete removal. Allow the screw to drain for an hour and blow dry using a water-free airline. Lightly oil with a mineral based lubrication oil (Mobil DTE 24 or similar) ensuring all moving parts are lubricated. Fit a plastic ball (BM part number 8303822) to plug the radial lubrication hole not used — refer to the old screw for its correct position.

b) When refitting the axis thrust bearings ensure that the bearings are back-to-back, on Fafnir bearings, this is with the stamped faces of the outer rings together. To ensure best results the high points of eccentricity should be together so ensure the round burnish mark on each bearing is axially in line. If there is any doubt about the condition of these bearings they should be replaced.

c) The alignment of the ballscrew with the bedface and master guideway is critical and **must** be within 0.050 (0.002") along the full length of the ballscrew. When the screw alignment requirement has been set tighten the bearing cap screws to 9 Nm (80 lbin). Recheck the alignment of the ballscrew.

d) Wind the ballnut to the right hand end of the saddle prior to refitting the table. Ensure the ballnut is positioned with the lubrication hole uppermost, ready to refit the lubrication pipe.

e) Always refit the saddle end covers as soon as is practical and **never** run the machine under power without the saddle end covers in position.

ix) Adjust the X axis belt tension as per Section 7.1.1.

x) Reset the software limits as per Section 7.6.3.

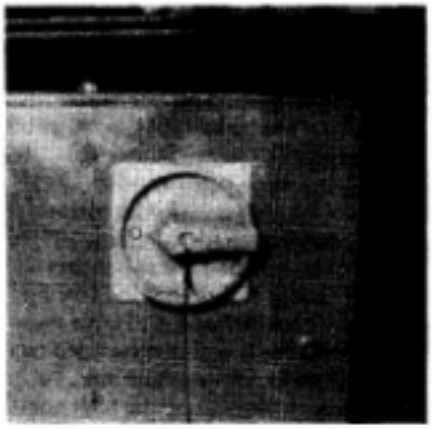
xi) Set the X axis gib strip and keep plate and check lost motion as per Section 7.9.1.

xii) Reset the X axis backlash compensation as per Section 7.9.2.

7.4.2
Y axis ballscrew assembly removal

To ensure that no damage occurs to the Y axis ballscrew during this procedure, two people are required, one to withdraw the knee front bracket and maintain the alignment of the assembly, whilst the second person removes the pulley and guides the ballscrew from the knee.

WARNING:
Disconnect power to the machine by throwing the main circuit breaker to the **OFF** position.



Isolator in OFF position

i) Remove the two neoprene covers on the top of the knee.

ii) Remove the drive belt housing cover and handwind the saddle forward.

iii) Remove the stop pin on the knee front bracket and slide covers forward.

Stop pin

iv) Remove the T inspection plate at the rear of the top of the knee.

v) Remove the acess hole cover on the left hand side of the knee.

vi) Slacken the belt tension screw on the motor bracket above the motor flange.

T inspection plate

Dowel pin

vii) Support the motor and remove the four screws securing the motor and remove the motor. The dowel pin, underneath the tension screw, will be released so make sure this item is located.

viii) Remove the two fixing screws from the top corners of the knee front bracket and replace with two screws 5/16 UNC x 5" long. These new screws will allow the front bracket complete with the Y axis ballscrew to be slid forward to give clearance to remove the drive belt.

Fixing screws

ix) From the access hole in the knee remove the formed copper lubrication pipe from the top of the ballnut. Remove the four screws securing the ballnut from its nut bracket.

x) Measure and record the distance from the ballscrew pulley to the bearing housing. On reassembly this figure will be used to fix the pulley in its original position. Release the taper lock holding the pulley.

xi). Withdraw the front bracket dowels and remaining fixing screws and carefully pull forward the front bracket complete with the ballscrew assembly. The second person should guide the rear of the leadscrew to maintain its position and avoid damage.

xii) The drive belt and pulley is now slid off the rear of the leadscrew. Support the front bracket and remove the two support screws. The ballscrew assembly can be withdrawn from the front of the knee. Disassemble the ballscrew from the front bracket.

Front bracket

xiii) To replace a new ballscrew reverse the disassembly procedure, paying particular attention to the following:

Drive belt **Pulley**

a) The ballscrew assembly is supplied from the manufacturer protected in lanolin, and this **must** be completely removed. Wash the assembly by completely immersing in **CLEAN** white spirit **(NOT PARAFFIN)** and brushing well. Run the ballnut up the full length of the screw to ensure complete removal. Allow the screw to drain for an hour and blow dry using a mineral based lubricating oil (Mobil DTE 24 or similar) ensuring all moving parts are lubricated. Fit a plastic ball (BM part number 8303822) to plug the radial lubrication hole not used – refer to the old screw for its correct position.

b) When refitting the axis thrust bearings ensure that the bearings are back-to-back, on Fafnir bearings, this is with the stamped faces of the outer rings together. To ensure best results the high points of eccentricity should be together so ensure the round burnish mark on each bearing is axially in line. If there is any doubt about the condition of these bearings, they should be replaced.
The fixing screws on the bearing cap should be tightened to a torque of 34 Nm (25 lbft).

c) As long as the rear bearing remains untouched in the knee, the alignment of the ballscrew should be maintained. If the alignment is lost then it is necessary to remove the saddle, as described in Section 7.3.2 and the alignment reset. The alignment of the ballscrew with the bedface and master guideway is critical and **must** be within 0.030 (0.0012") along the full length of the ballscrew. Recheck the alignment when the fixing screws have been tightened.

xiv) Adjust the Y axis belt tension as per Section 7.1.2.

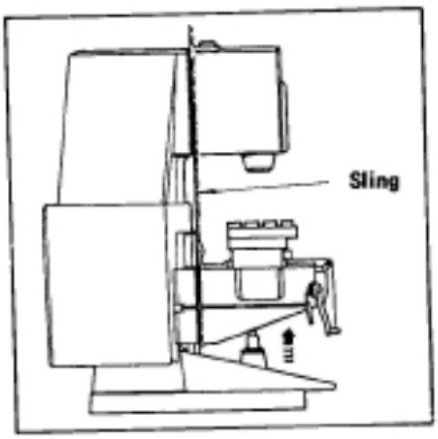
xv) Reset the software limits as per Section 7.6.7.

7.5 AIR ASSIST PEDESTAL

7.5.1 Removal

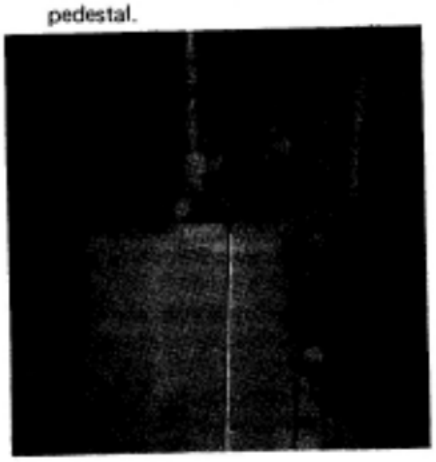
NOTE:
Due to the requirement for the cylinder to be air tight, the cylinder sleeve is considered an integral part of the pedestal assembly and is removed as a unit.

i) Raise the knee to a sufficient height (not the total travel) to allow access to the pedestal and elevating nut. Lock the knee in that position and in addition support the knee with a rope sling.



CAUTION:
The assembled knee weighs 875 kg (1930 lb). Use appropriate care to prevent equipment damage and personal injury.

ii) Discharge the air from the cylinder and disconnect the air hose and lubrication line from the top of the pedestal.



Air hose

iii) Remove the screws securing the leadscrew nut mount from the pedestal.

iv) Hoist the knee to full travel height, pulling the leadscrew out of the pedestal along with the packing cup, packing retainer, leadscrew bumper, thrust bearing and bearing retainer.

v) Remove the two pedestal mounting screws and remove the pedestal from the base.

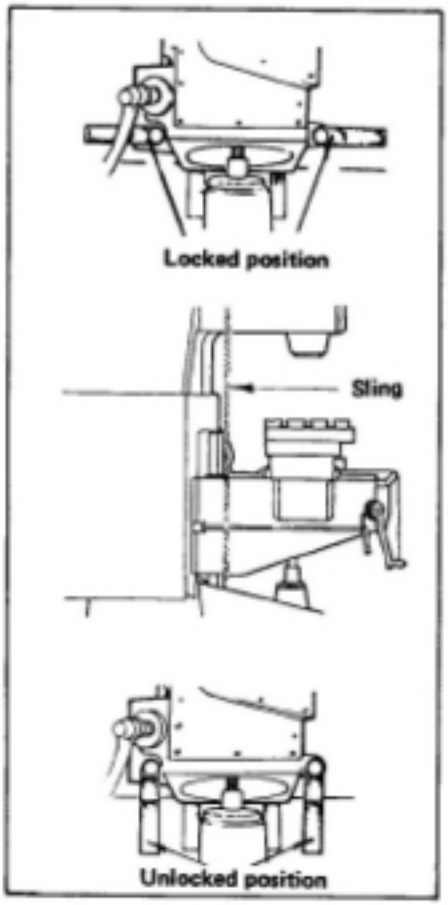
7. BASE ASSEMBLY AND MAINTENANCE (cont.)

Pedestal mounting screws

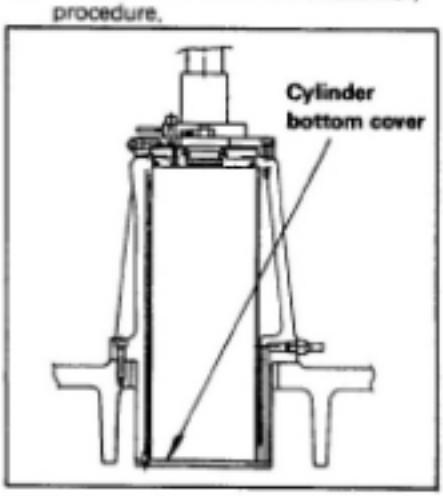
7.5.2
Cylinder gasket removal

i) Raise the knee to a position close to the topmost working position. Lock the knee in that position and in addition support the knee with a rope sling.

CAUTION:
The assembled knee weighs 875 kg (1930 lb). Use appropriate care to prevent equipment damage and personal injury.

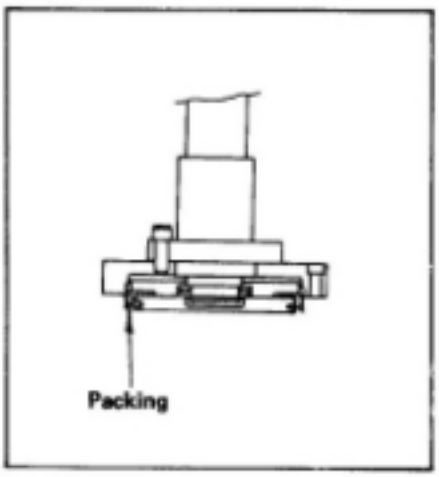


ii) Remove the pedestal mounting screws and handwind the elevating screw to withdraw the pedestal from the base to gain access to the bottom fixing screws.
iii) Remove the screws securing the cylinder bottom cover and replace the cylinder cover gasket.
iv) To assemble reverse the disassembly procedure.



7.5.3
Packing cup replacement

i) Remove the pedestal as described in Section 7.5.1.
ii) Remove the screws securing the packing retainer, remove the retainer and packing.
iii) Replace with Bridgeport supplied packing (BM part number 2152121). It is important that this packing has been soaked in a mineral based lubricant (Mobil DTE 24 or equivalent) for at least 12 hours prior to assembly. Care must be taken to ensure that the coil spring is in position during assembly.



7.6 LIMIT SWITCH REPLACEMENT

7.6.1
X axis extreme limit dogs

The available stroke of the table is determined by the software limits set in the machine control. The extreme limit dogs exist only as an additional safeguard to shut off power to the axis drive in the event of a control or drive malfunction which causes the table to go outside its software limits.

i) In order to set the extreme limit dogs it is necessary to override the software limits.
Change parameter 44 to +1000
Change parameter 45 to -1000

CAUTION:
The X axis software limits are now inactive. Use the handwheel only. Approach the ballscrew positive stops at a creep feed rate.

Handwheel

ii) Using the handwheel, position display and the power enable lamp, set the dogs to give an axis stroke of 751 mm to 752 mm central to the traverse between positive ballscrew stops.
iii) Reset the X axis reference dog as per Section 7.6.2.
iv) Reset the machine software limits as per Section 7.6.3.

7.6.2
X axis reference dog

The axis reference dog is used in conjunction with the encoder on the motor shaft to determine the machine datum following an interruption of mains power.

i) When resetting the reference dog first temporarily set it to operate between 8 mm and 10 mm before the extreme.

ii) Switch off the main isolator. Switch on the machine isolator and pass over the reference points as normal.

iii) Place the control in reference mode by pressing [MDI] until "POSITION DATA" is displayed. Press [SHIFT] until [REF] is displayed.

iv) Re-adjust the axis reference dog to operate the reference switch at between -1.0 mm and -1.5 mm as read on the position readout display.

v) Reset the machine software limits as per Section 7.6.3.

7.6.3
X axis software limits

After changing a feed motor, a feed drive belt, or an axis limit switch, it is necessary to reset the software limits.

i) Temporarily override the software limits.
Change parameter 44 to +1000
Change parameter 45 to -1000

CAUTION:
The X axis software limits are now inactive. Use the handwheel only. Approach the ballscrew positive stops at a creep feed rate.

Handwheel

ii) Place the control in reference mode

iii) Slowly handwind the axis and record the position display figure as the positive extreme limit switch just operates.

iv) Deduct 0.4 mm from the reading, to obtain the positive software limit figure.

v) Deduct 750.1 mm from the positive software limit figure to obtain the negative software limit figure.

vi) Enter these values as follows:
Machine parameter 44 positive software limit (X axis)
Machine parameter 45 negative software limit (X axis)

vii) Using the joystick in rapid, check that the table can be run onto its software limits, and off again, without tripping the extreme limits.

viii) Exit from the control reference

ix) Check that at least 750 mm of stroke can be achieved.

x) Record the new software limits on the Machine Software Parameter Record which may be found in the door pocket of the electrical cabinet.

7.6.4
X axis limit switch replacement

To remove an X axis limit switch (located on the rear surface of the saddle) turn off the power and proceed as follows:

i) Remove the bottom cover plate from the limit switch.

ii) Unscrew the large hexagon nut(s) on the electrical cable connection and disconnect the cable from the limit switch.

X limit switch

iii) Remove the two screws securing the limit switch to the mounting plate on the saddle.
Install the new limit switch by reversing the above procedure. Vertical adjustment of the limit switch may be achieved by slackening the two screws securing the mounting plate to the saddle.

NOTE:
After installation of the limit switch check the X axis reference dog adjustment as per Section 7.6.2 steps (ii) to (v). If necessary reset the X axis extreme limit dogs as per Section 7.6.1.

7.6.5
Y axis extreme limit dogs

The available stroke of the saddle is determined by the software limits set in the machine control. The extreme limit dogs exist only as an additional safeguard to shut off power to the axis drive in the event of a control or drive malfunction which causes the table to go outside its software limits.

i) In order to set the extreme limit dogs it is necessary to override the software limits.
Change parameter 46 to +1000
Change parameter 47 to -1000

CAUTION:
The Y axis software limits are now inactive. Use the handwheel only. Approach the ballscrew positive stops at a creep feed rate.

ii) Using the handwheel, position display and the power enable light, set the dogs to give an axis stroke of 361 mm to 362 mm central to the traverse between positive ballscrew stops.

iii) Reset the Y axis reference dog as per Section 7.6.6.

iv) Reset the machine software limits as per Section 7.6.7.

7.6.6
Y axis reference dog

The axis reference dog is used in conjunction with the encoder on the motor shaft to determine the machine datum following an interruption of mains power.

i) When resetting the reference dog first temporarily set it to operate between 8 mm and 10 mm before the extreme.

ii) Switch off the machine isolator. Switch on the machine isolator and pass over the axis reference points as normal.

iii) Place the control in reference mode

iv) Readjust the axis reference dog to operate the reference switch at between -1.0 mm and -1.5 mm as read on the position readout display.

v) Reset the machine software limits as per Section 7.6.7.

7.6.7
Y axis software limits
After changing a feed motor, an encoder, or feed drive belt on an axis limit switch, it is necessary to reset the software limits.

i) Temporarily override the software limits.
Change parameter 46 to +1000.
Change parameter 47 to -1000

CAUTION:
The Y axis software limits are now inactive. Use the handwheel only. Approach the ballscrew positive stops at a creep feed rate.

ii) Place the control in reference mode

iii) Slowly handwind the axis and record the position display figure as the positive extreme limit switch just operates.

iv) Deduct 0.4 mm from the reading, to obtain the positive software limit figure.

v) Deduct 360.1 mm from the positive software limit figure to obtain the negative software limit figure.

vi) Enter these values as follows:
Machine parameter 46 positive software limit (Y axis)
Machine parameter 47 negative software limit (Y axis)

vii) Using the joystick in rapid, check the saddle can be run onto its software limits, and off again without tripping the extreme limits.

viii) Exit from the control reference

ix) Check that at least 360 mm of stroke can be achieved.

x) Record the new software limits on the Machine Software Parameter Record which may be found in the door pocket of the electrical cabinet.

7.6.8
Y axis limit switch replacement
To remove the Y axis limit switch (located underneath the saddle at the right hand side of the knee) turn off power and proceed as follows:

i) Remove the cover plate from the rear of the limit switch.

ii) Unscrew the large hexagon nut on the electrical cable connector and disconnect the cable from the limit switch.

Y limit switch

iii) Remove the two screws securing the limit switch to the mounting plate on the saddle.
Install the new limit switch by reversing the above procedure.
Adjustment of the limit switch may be achieved by slackening the two screws securing the mounting plate to the saddle.

NOTE:
After installation of the limit switch check the Y axis reference dog adjustment as per Section 7.6.6 steps (ii) to (v). If necessary reset the Y axis extreme limit dogs as per Section 7.6.5.

7.7 LUBRICATION

7.7.1
X, Y and Z axes
The table, saddle and head quill are lubricated by an automatic system that operates whenever the spindle is rotating.

Lubrication pump

The oil reservoir and pump are located in a cabinet at the side of the machine column.

A float switch in the oil reservoir prevents restart of the feed drive if the oil level is too low.

NOTE:
The switch will not stop the machine while it is in operation but it will protect against restarting without sufficient lubrication.

Oil distributors for the table and saddle are located inside the saddle and can be exposed by removing the table. For instructions on table removal see Section 7.3.1. Oil distributors for the head quill are located on the left side of the column.

CAUTION:
Use only Mobil Vactra No. 2 or equivalent to ensure maximum effectiveness of the lubrication system.

All other moving parts such as bearings, gears etc., are prepacked with lifetime grease at the factory and should not require further servicing for their full service life.

7.7.2
Knee lubrication
The knee ways are lubricated by automatic system from a distributor located inside the knee. External feeder hoses are attached to the left side of the knee. All bearings are greased for life. Lubrication of the knee elevating screw is through a grease fitting at the top of the pedestal.

7.8 X AND Y AXIS GIBS

7.8.1
Adjustment of table and saddle gibs
At the factory all the gibs are given an initial setting, the machine is cycled for approximately 50 hours and then the gibs are given a final setting. Therefore they should not require readjusting if proper maintenance of automatic lube system is provided. In the event that gib adjustment is required, however, proceed as follows in Section 7.8.2 or 7.8.3.

7.8.2
Saddle to table gib setting (see Figure 7-1)

i) Set up indicators in position no. 1.
ii) Push end of table and release, pull end of table and release. Note the total indicator reading (less spring back).
iii) Adjust the gib, by turning the adjusting screw to obtain a maximum indicator reading (less spring back) of .0005".
iv) After gib is set, move indicator to position no. 2.
v) Push and pull on end of table. Note the total indicator reading (less spring back).
vi) Total indicator reading in position no. 1 (after gib is set) should equal the total indicator reading in position no. 2 within ± .0002", if not, remove and scrape the gib and repeat setting.
vii) Check lost motion as per Section 7.9.1.

7.8.3
Saddle to knee gib setting (see Figure 7.2)

i) Move the saddle to position no. 1. and set up indicator.
ii) Push the end of the table and release, pull the end of the table and release. Note the total indicator reading (less spring back).
iii) Adjust the gib by turning the adjusting screw, to obtain a maximum indicator reading (less spring back) of .0005".
iv) After the gib is set, move the saddle to position no. 2 and set up the indicator.
v) Push and pull on the end of the table. Note the total indicator reading (less spring back).
vi) The total indicator reading in position no. 1 (after the gib is set) should equal the total indicator reading in position no. 2 within ± .0002", if not, remove and scrape the gib and repeat the setting.
vii) Check lost motion as per Section 7.9.1.

7.8.4
Knee to column gib setting

i) Remove the way wiper cover (8005096) and wiper (8005099) to expose the knee to column gib.
ii) Manually, using the crank handle, raise and lower the knee and turn the adjusting screw (8006088) until a smooth movement is attained.

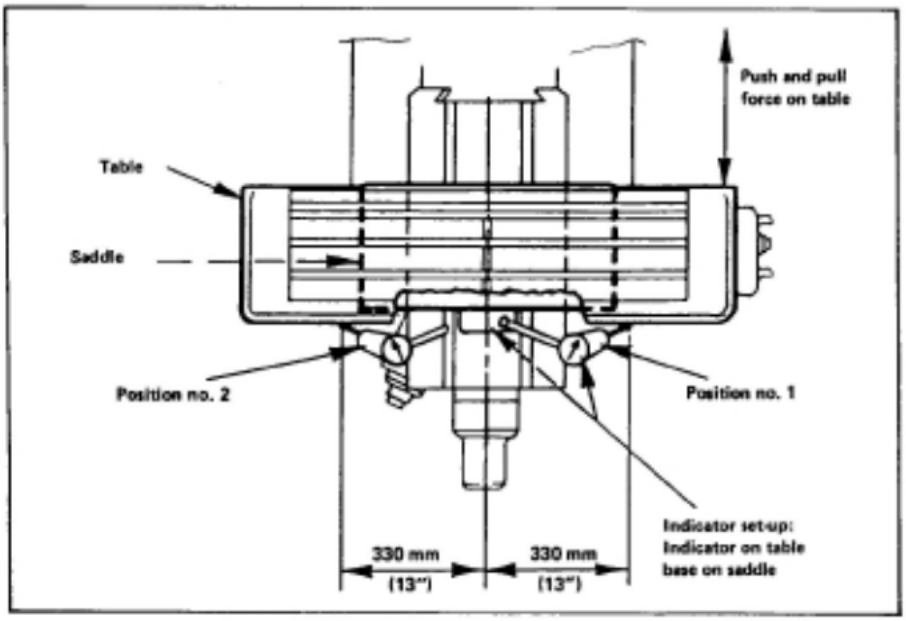


Figure 7.1 Saddle to table gib setting

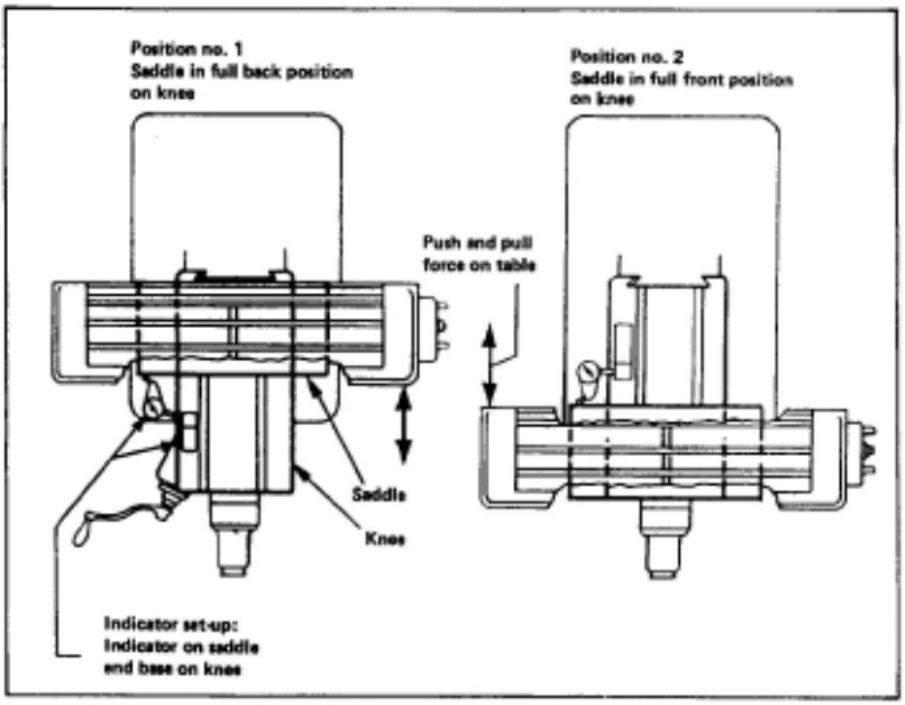


Figure 7.2 Saddle to knee gib setting

7.9 LOST MOTION AND BACKLASH COMPENSATION

NOTE:
In setting the gib strips, extreme care must be taken to ensure that they are not overtightened or lost motion or axis stall may occur; similarly if the gib strips are left too slack, lost motion, poor surface finish and poor repeatability may result. **It is essential therefore that when adjusting the gib strips, the correct procedure is followed and lost motion is checked to ensure that the optimum setting has been achieved.** Lost motion should be less than .025 mm (.001"); if this figure is exceeded, slacken the gib strip by one quarter of a turn and recheck. **It should also be noted that lost motion may be promoted if an inappropriate slideway lubricant is used.**

7.9.1
To check lost motion
Pre-requisites

i) Gib strips set as per Section 7.8.1, 7.8.2 or 7.8.3.
ii) Zero backlash compensation has been entered into the TNC software parameters 36 for X axis or 37 for Y axis. (Follow procedure as per Section 7.9.2 but enter zero).

Equipment
Dial gauge (reading to .002 mm or better and having a travel greater than 2 mm), clock stand with magnetic base.
Measurement procedure

i) Apply knee locks.
ii) Move the axis to be checked to its mid position.
iii) Align the dial gauge along the axis to be checked as shown in Figure 7-1 or 7-2.
iv) Using handwind, bring the dial gauge into contact with the quill and move to the mid stroke of the gauge.
v) Zero the axis DRO and the dial gauge.
vi) Using manual data input, move to +1 mm at a feed rate of 1000 mm/min and back to 0. Check that the DRO reading is zero, and note the dial gauge reading (ignoring the sign).
vii) Rapid to -1 mm and back to 0.
viii) If the DRO does not read zero, or the dial gauge reads zero within .002 mm repeat steps (v) to (vii).
ix) Enter backlash compensation into the control unit as per Section 7.9.2. The lost motion should not exceed 0.025 mm (.001").

7.9.2
Backlash compensation

The lost motion remaining after the above gib setting procedure has been followed, may be virtually eliminated by means of the backlash compensation facility built into the control. To compensate for backlash, proceed as follows:

i) Measure lost motion as per Section 7.9.1.

ii) In manual mode press [MDI] until "CODE NUMBER =" is displayed. Key in 95148 and [ENT]

iii) Key [GO TO] followed by 36.

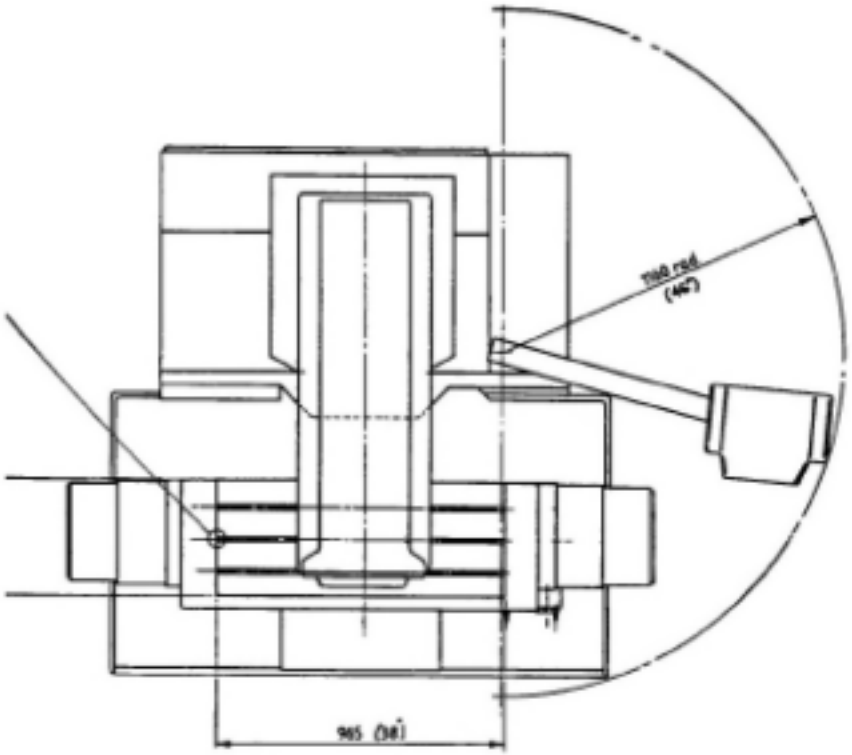
iv) Key in value of X axis lost motion (expressed in mm) and ENTER.

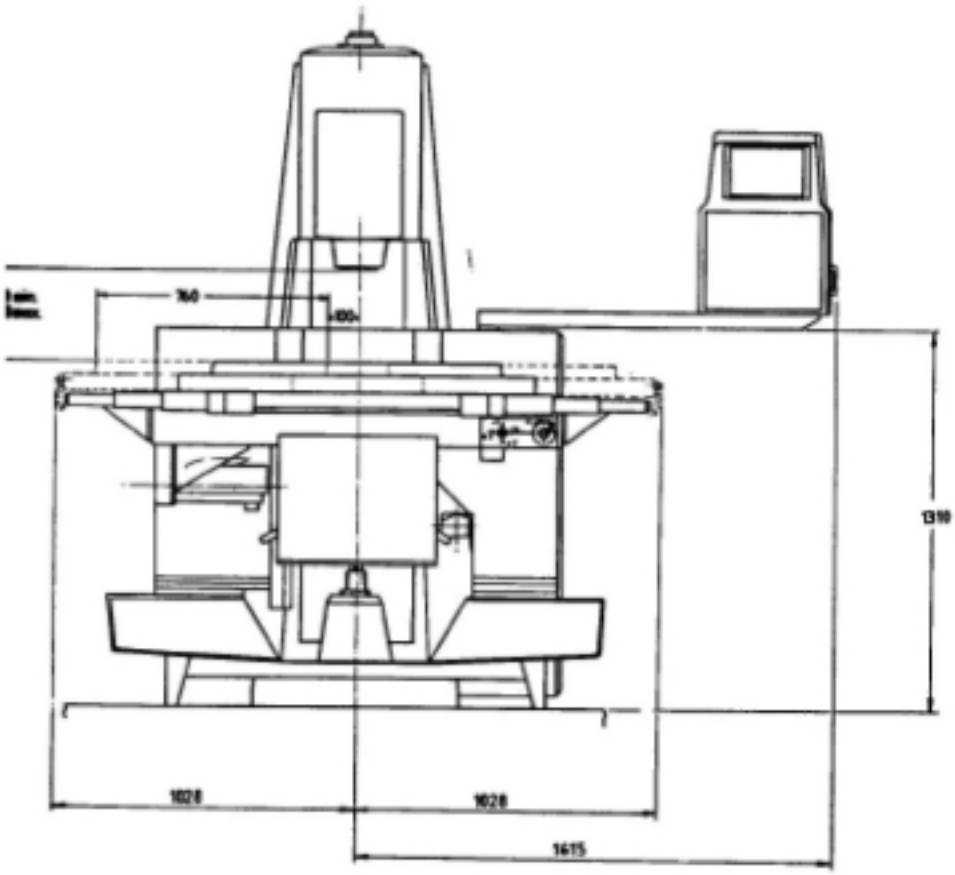
v) Page to line 37 and enter Y axis lost motion.

vi) Page to line 38 and enter Z axis lost motion.

vii) Press [DEL] and the parameter indication will go out.

viii) Record the new figures on the Machine Software Parameter Record which may be found in the door pocket of the electrical cabinet.





drawing

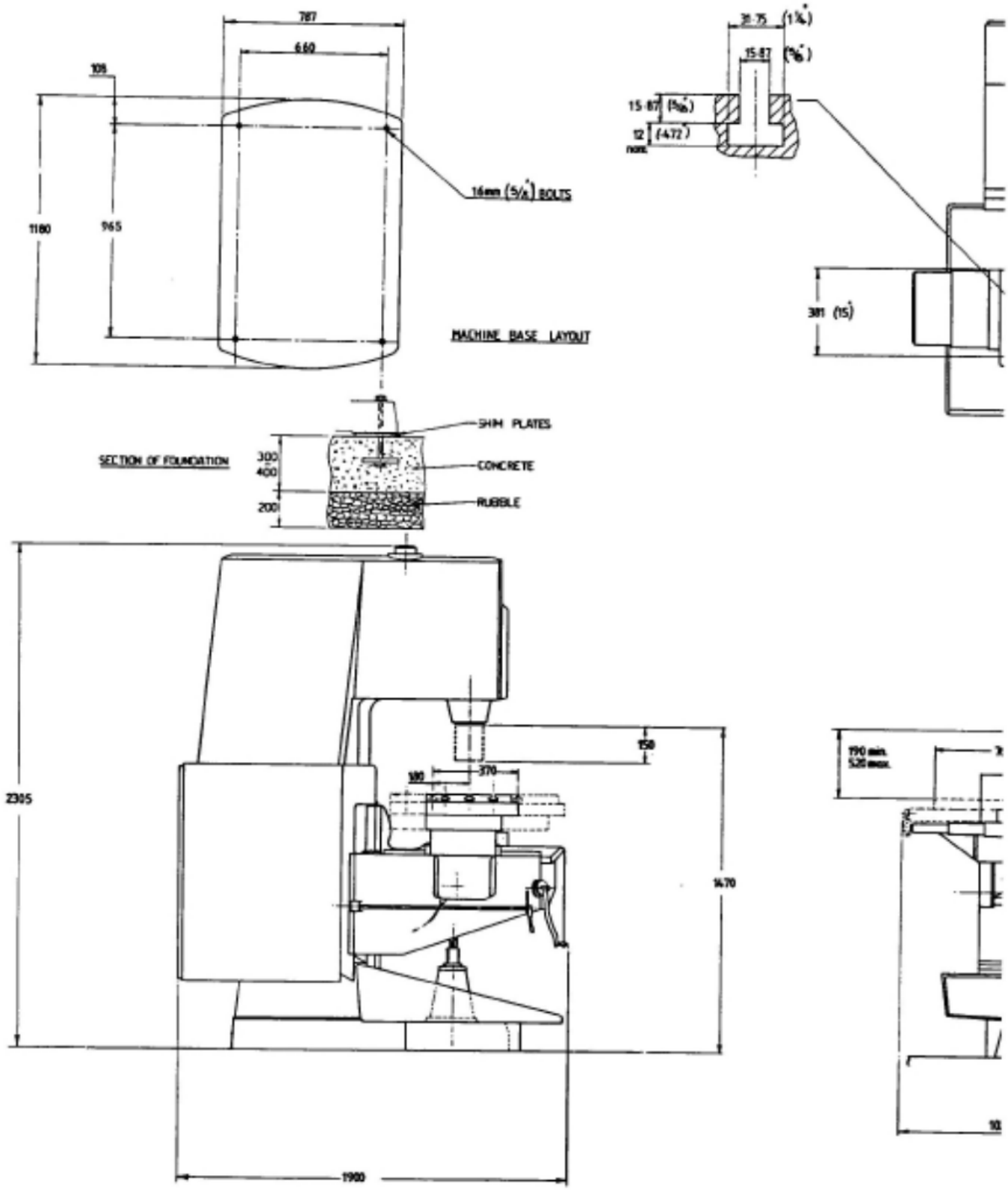
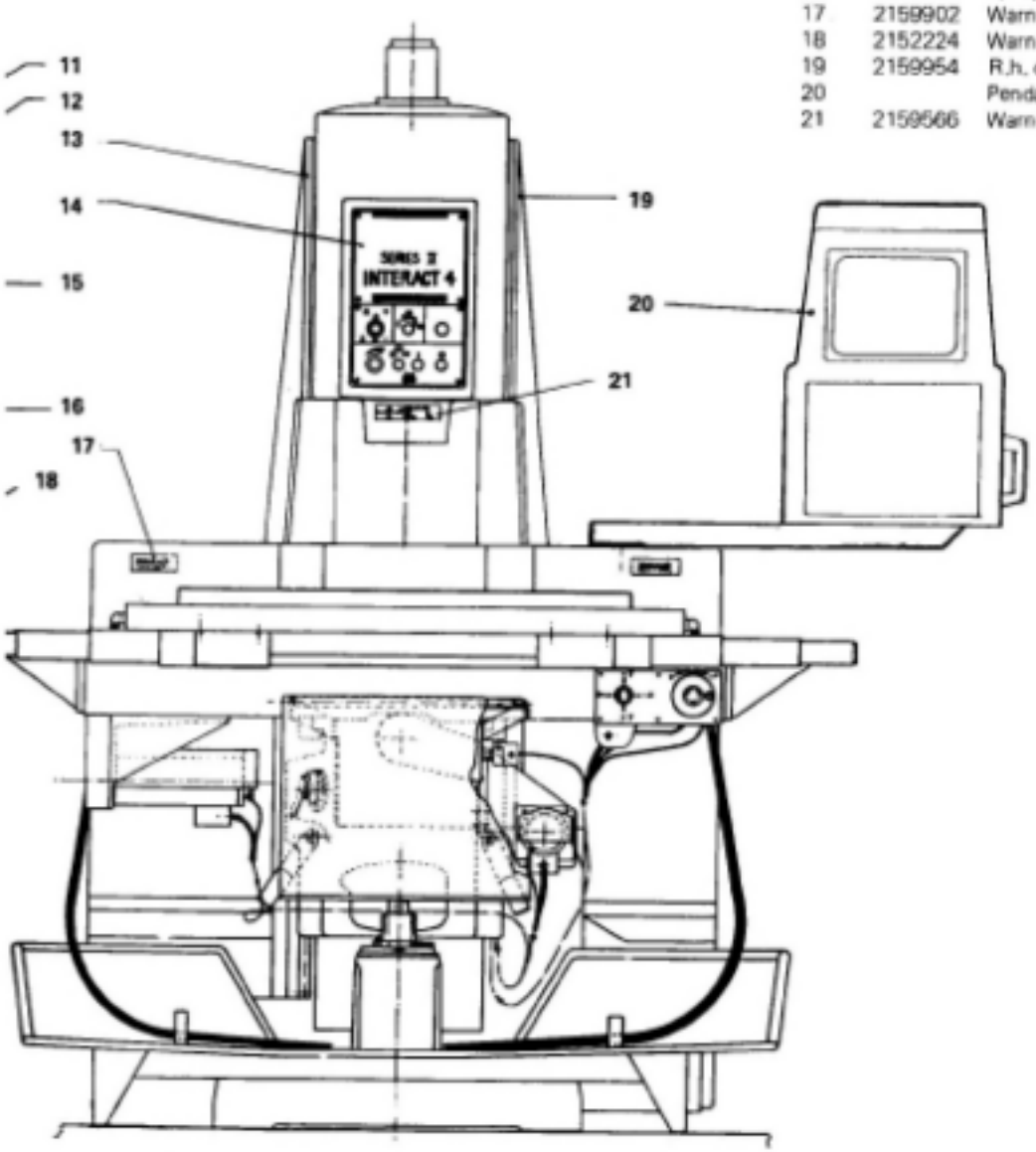


Figure 7-3 Specification drawing

Item	Part no.	Description	Qty.
1	2159975	Top cover	1
2	2159956	Nut for cover	10
3	2159957	Adjuster	10
4	1701028	Screw soc set	10
5	1705142	Nut	10
6	2159606	Blower extension	1
7	2159517	Gasket	1
8	2159966	R.h. support	1
9	2159967	L.h. support	1
10	4648405	Air services assy.	1
11	2159998	Transfer	2
12	2159999	Transfer	2
13	2159955	L.h. cladding	1
14	2159964	Name plate	1
15	2159952	Switch box	1
16	4649861	Spray mist assy.	1
17	2159902	Warning plate	2
18	2152224	Warning plate	2
19	2159954	R.h. cladding	1
20		Pendant assy.	1
21	2159566	Warning plate	1



pment (sheet 1 of 2)

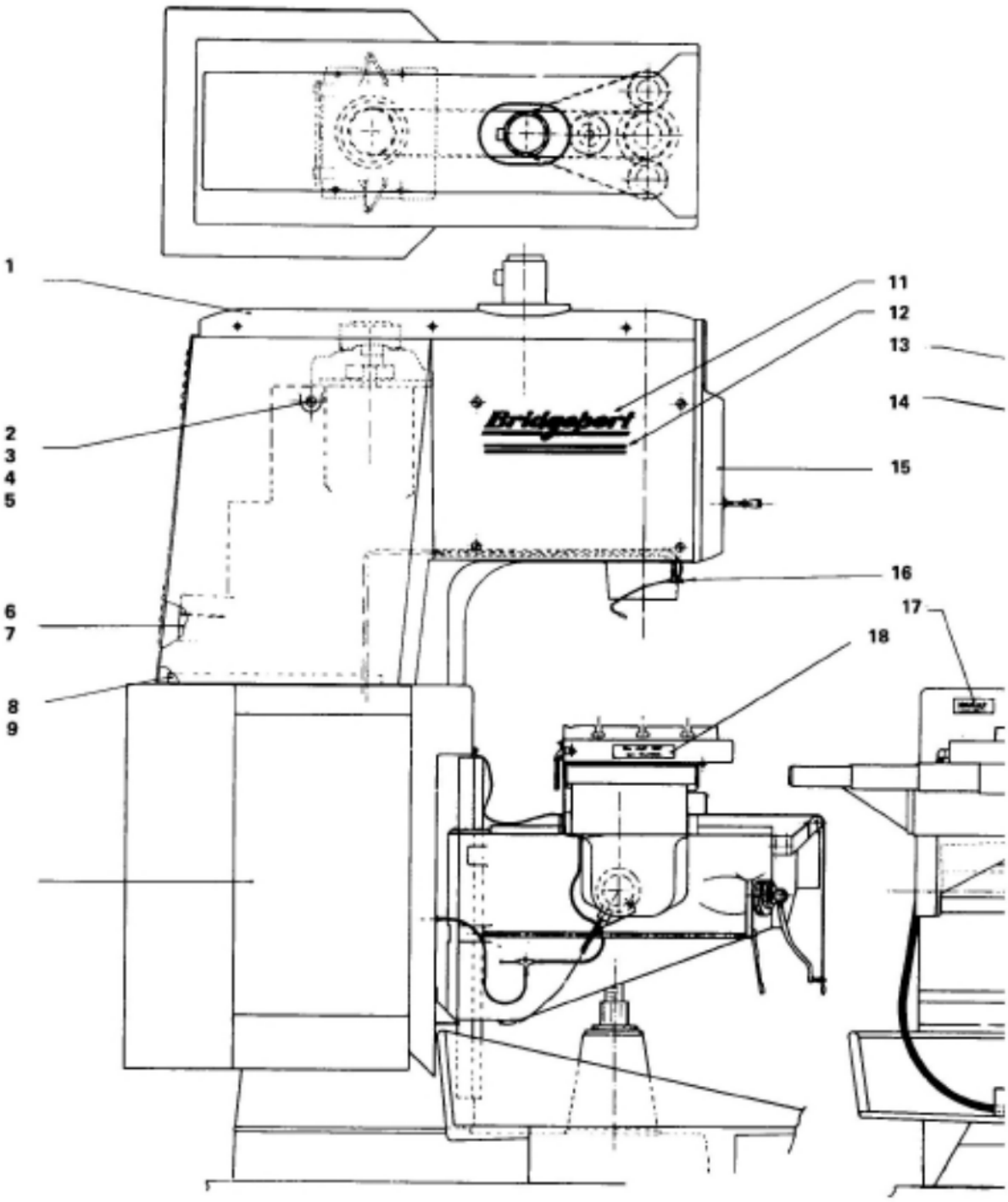
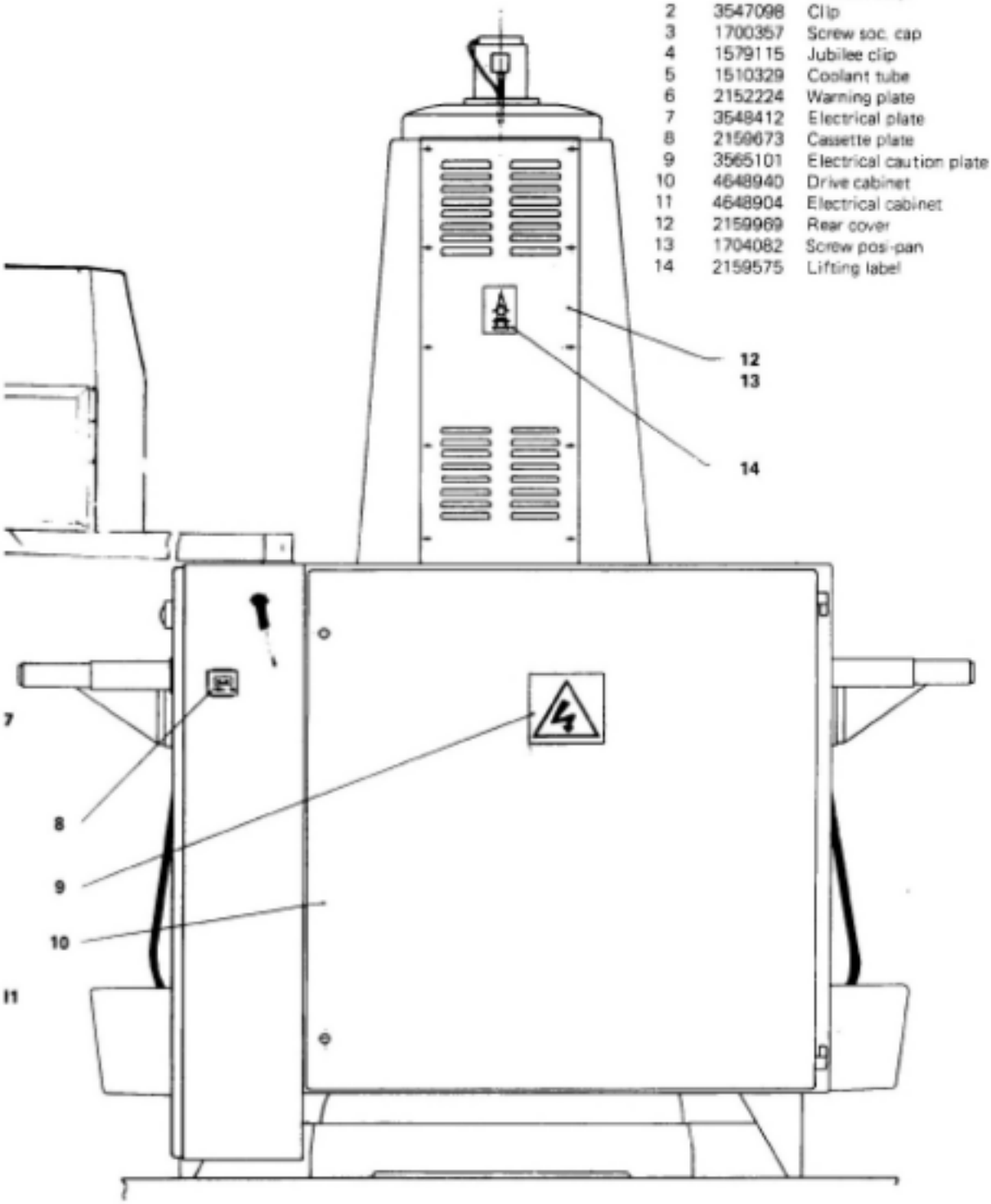


Figure 7-4 General arrangement (sheet 1 of 2

Item	Part no.	Description	Qty.
1	1570218	Coolant assy.	1
2	3547098	Clip	2
3	1700357	Screw soc. cap	2
4	1579115	Jubilee clip	1
5	1510329	Coolant tube	
6	2152224	Warning plate	2
7	3548412	Electrical plate	1
8	2159673	Cassette plate	1
9	3565101	Electrical caution plate	1
10	4648940	Drive cabinet	1
11	4648904	Electrical cabinet	1
12	2159969	Rear cover	1
13	1704082	Screw pos-pan	10
14	2159575	Lifting label	1



agement (sheet 2 of 2)

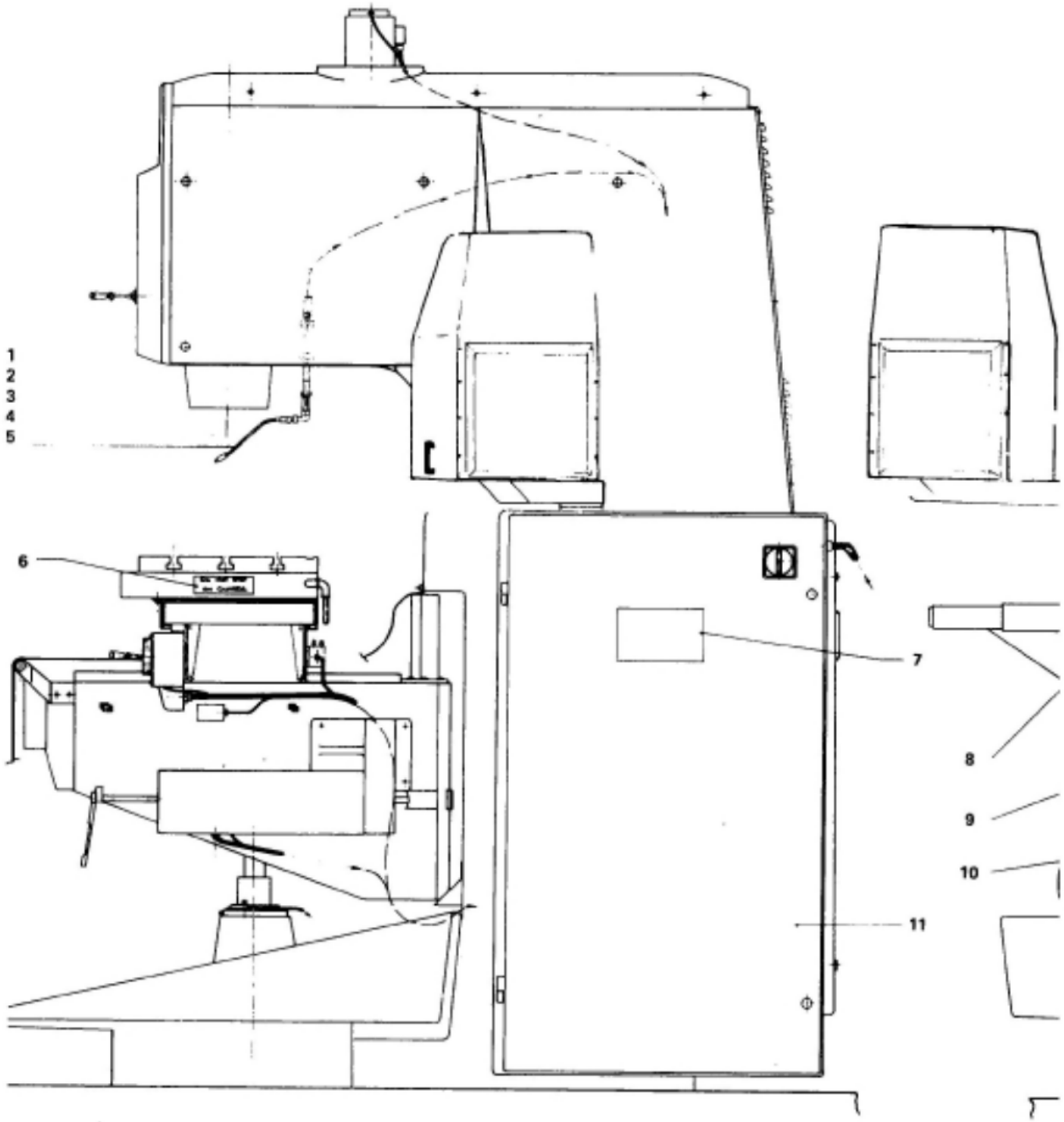
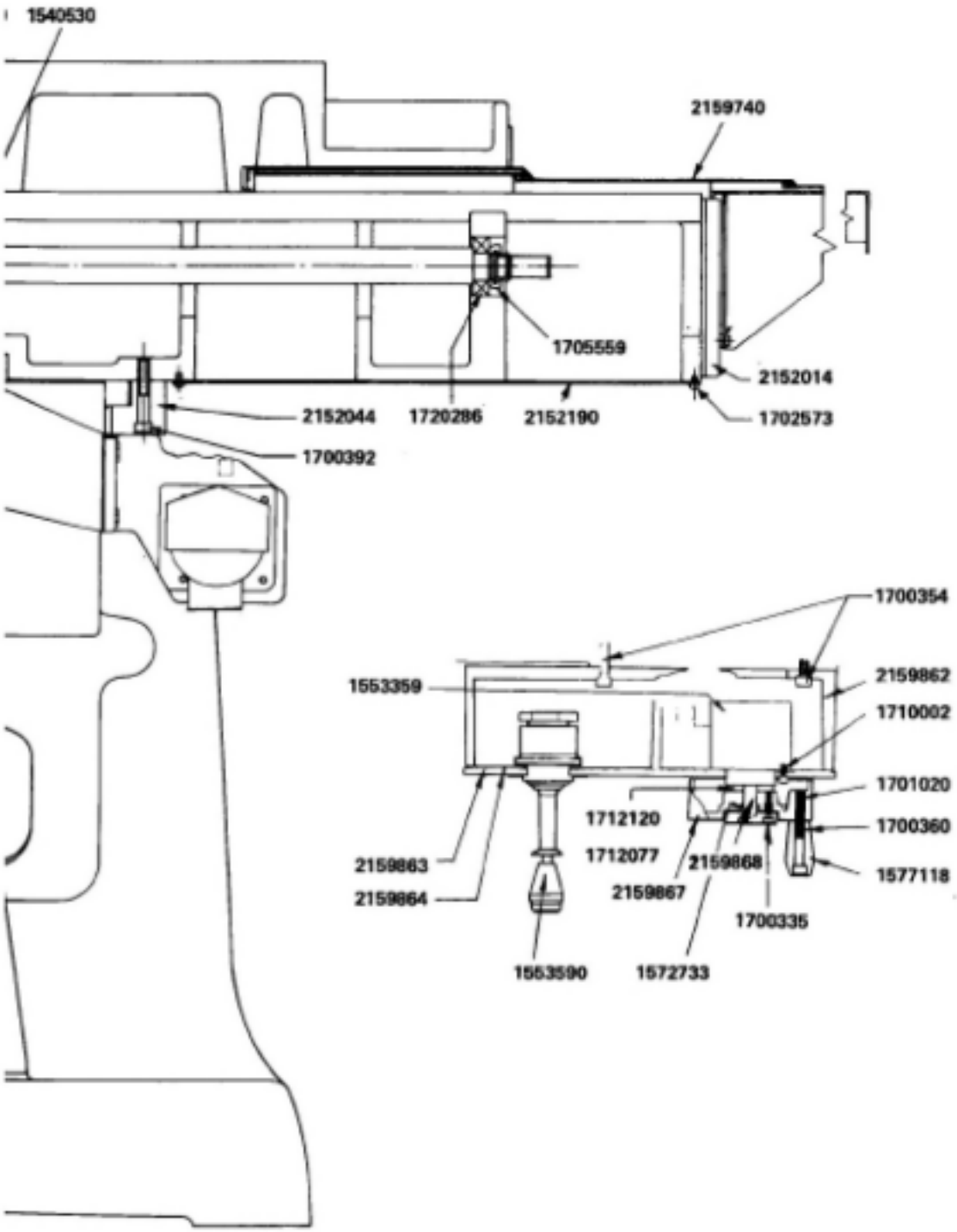


Figure 7-5 General arrangement (sheet 2 of



die arrangement

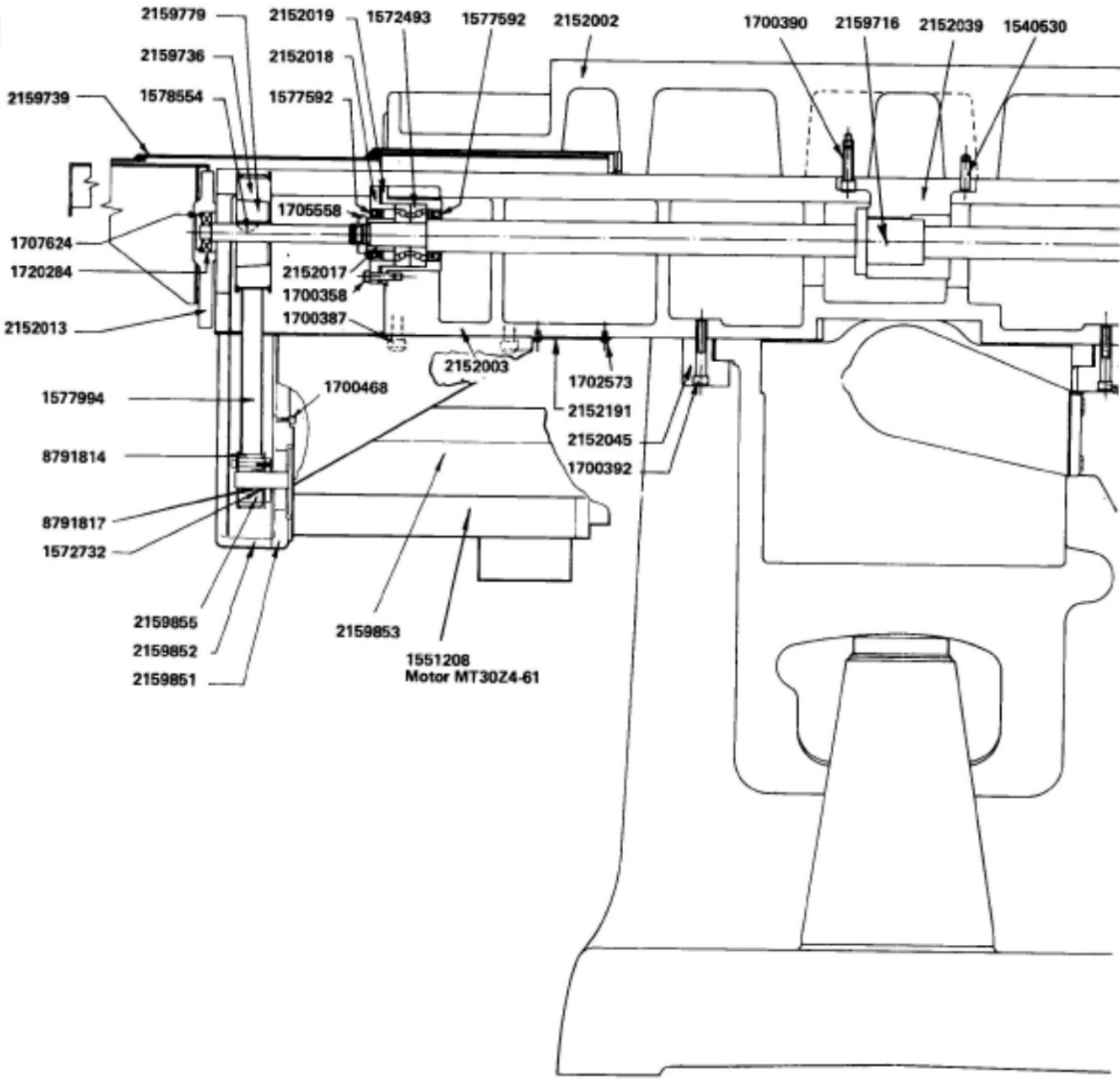
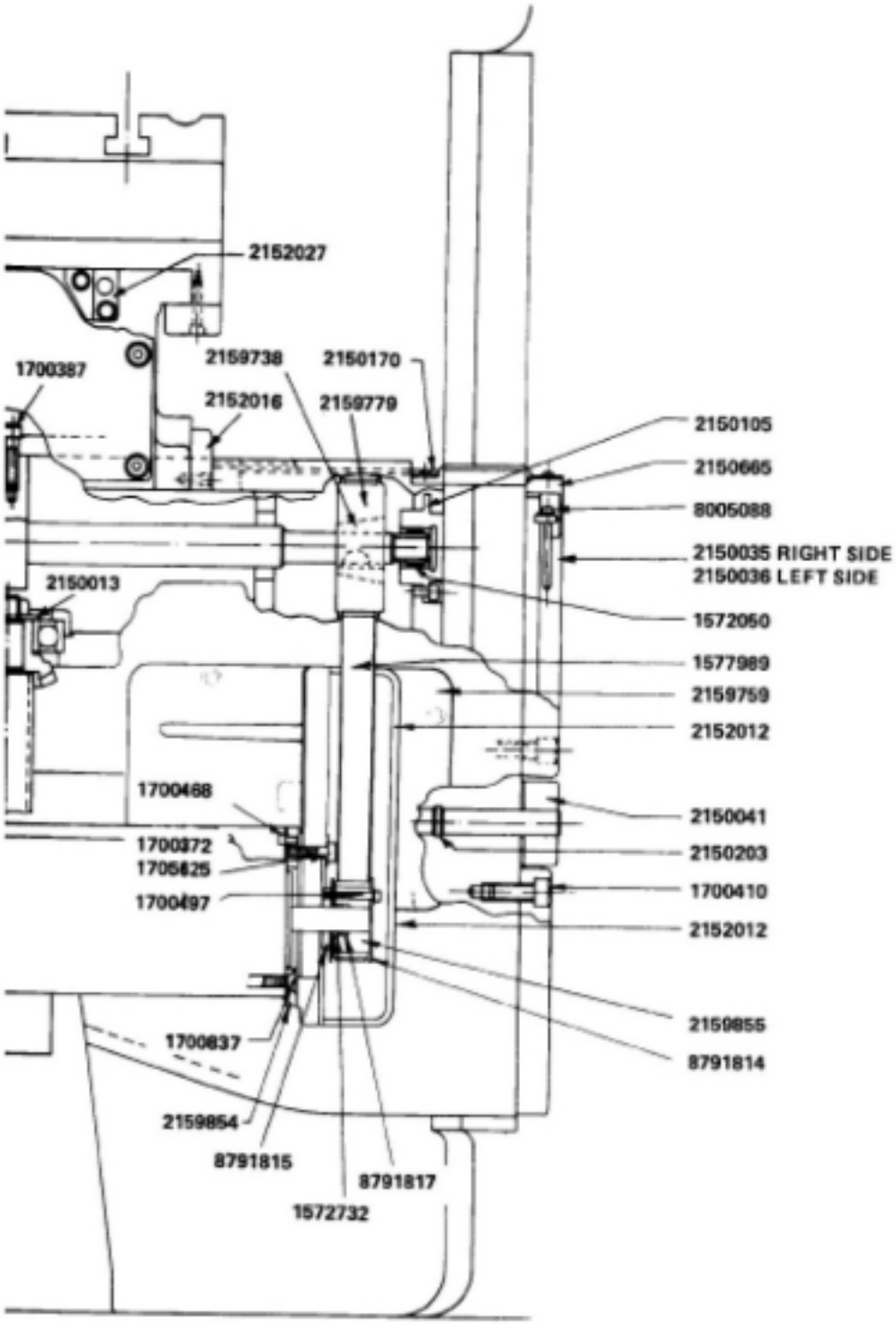


Figure 7-6 Table and saddle arrangement



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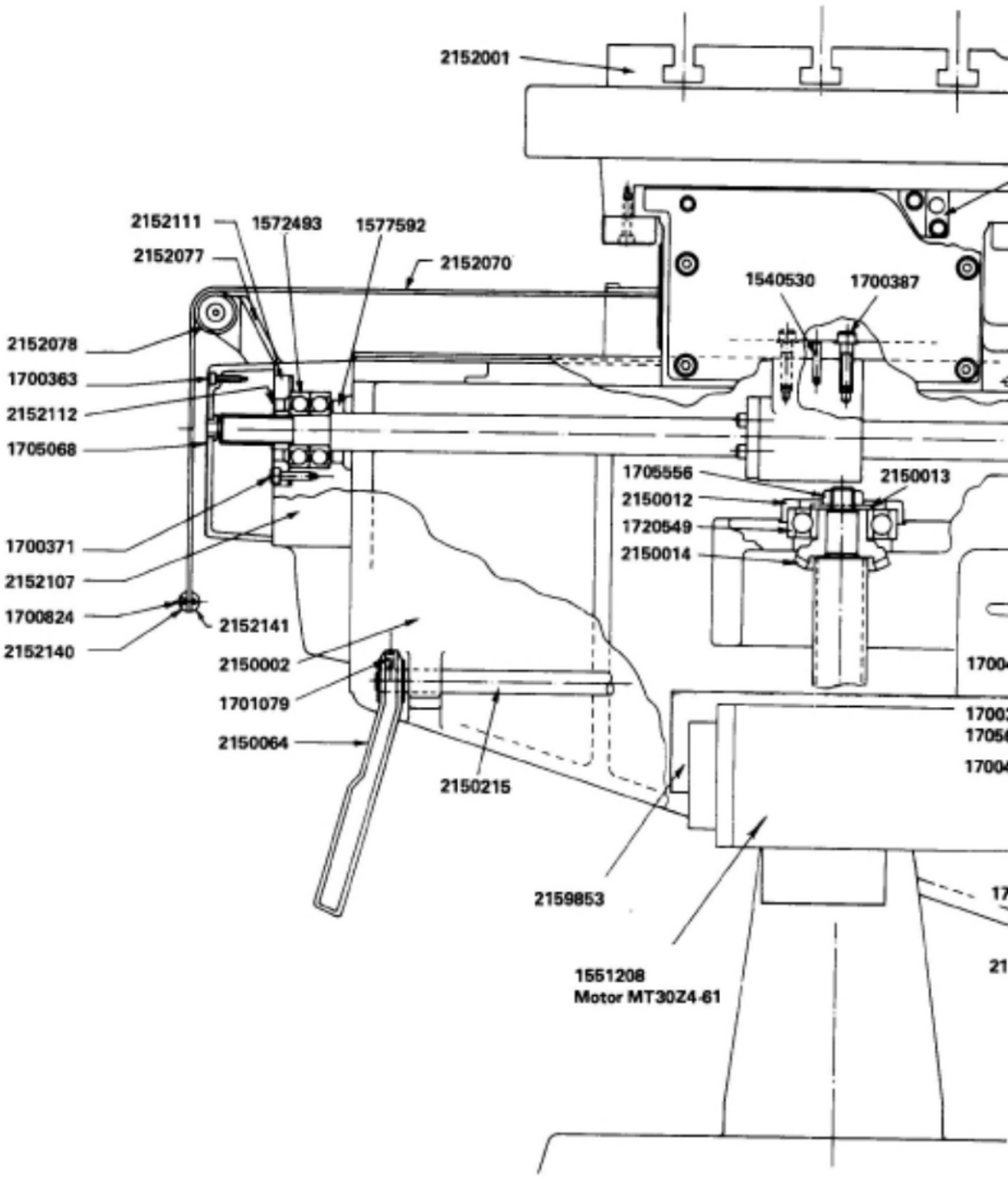
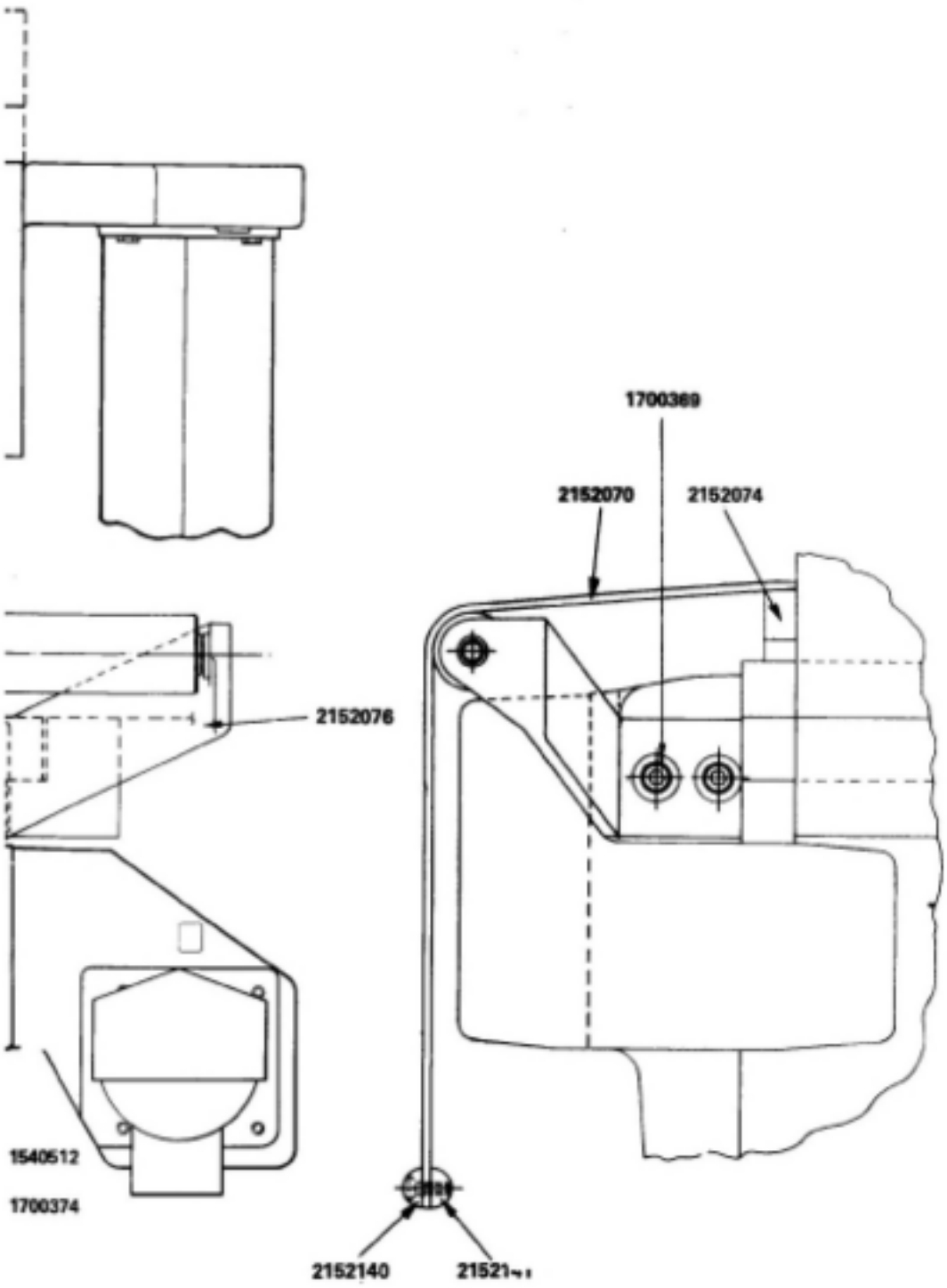


Figure 7-7 Knee arrangement (sheet 1 of 2)



see arrangement (sheet 2 of 2)

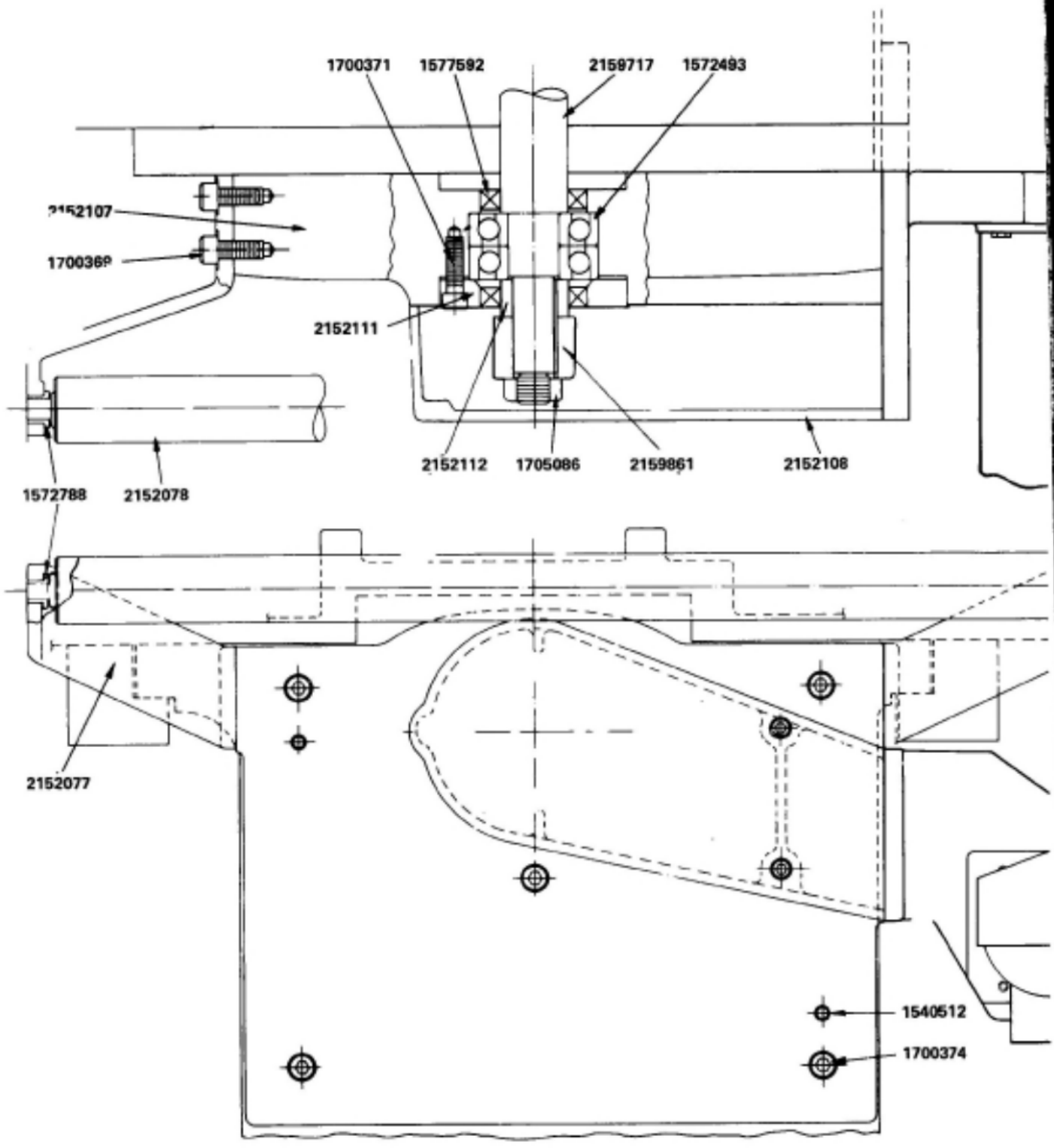
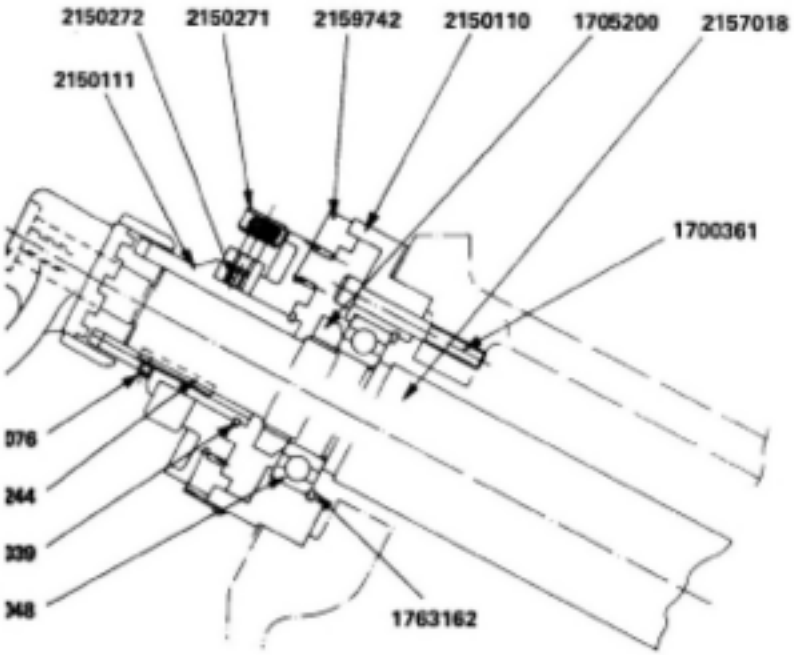


Figure 7-8 Knee arrangement (she


2150272
2150271
2159742
2150110
1705200
2157018
2150111
1700361
076
244
339
348
1763162

dial layout

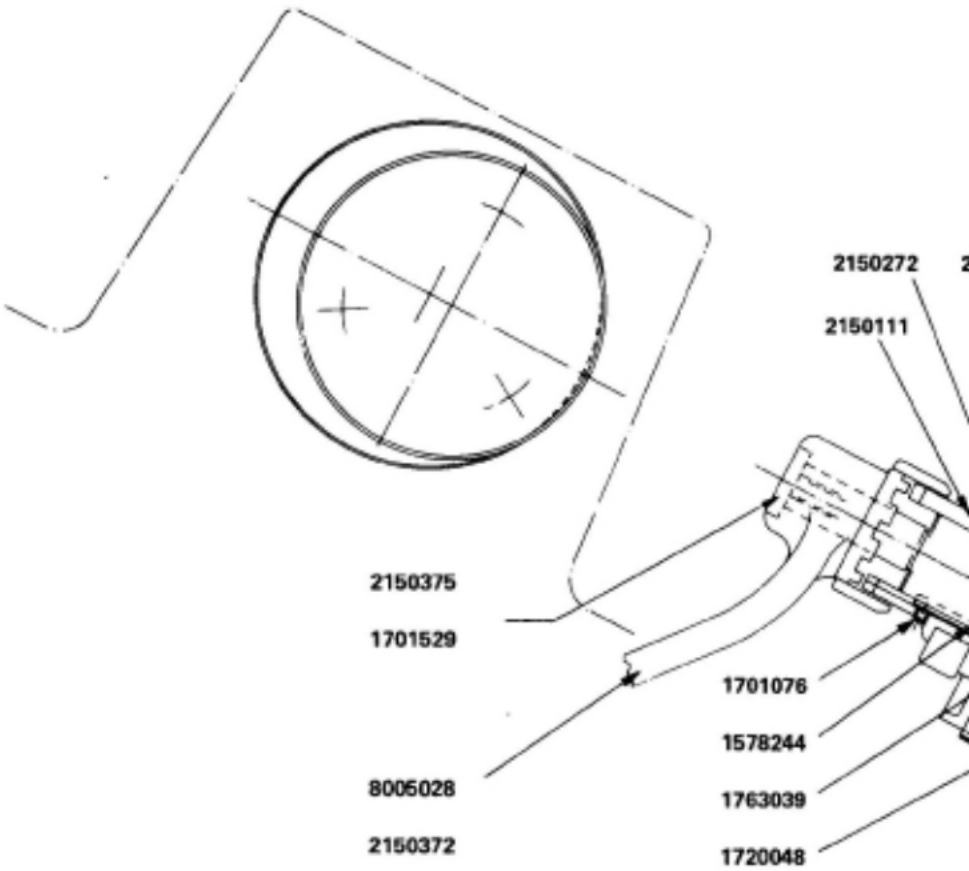


Figure 7-9 Dual dial layout

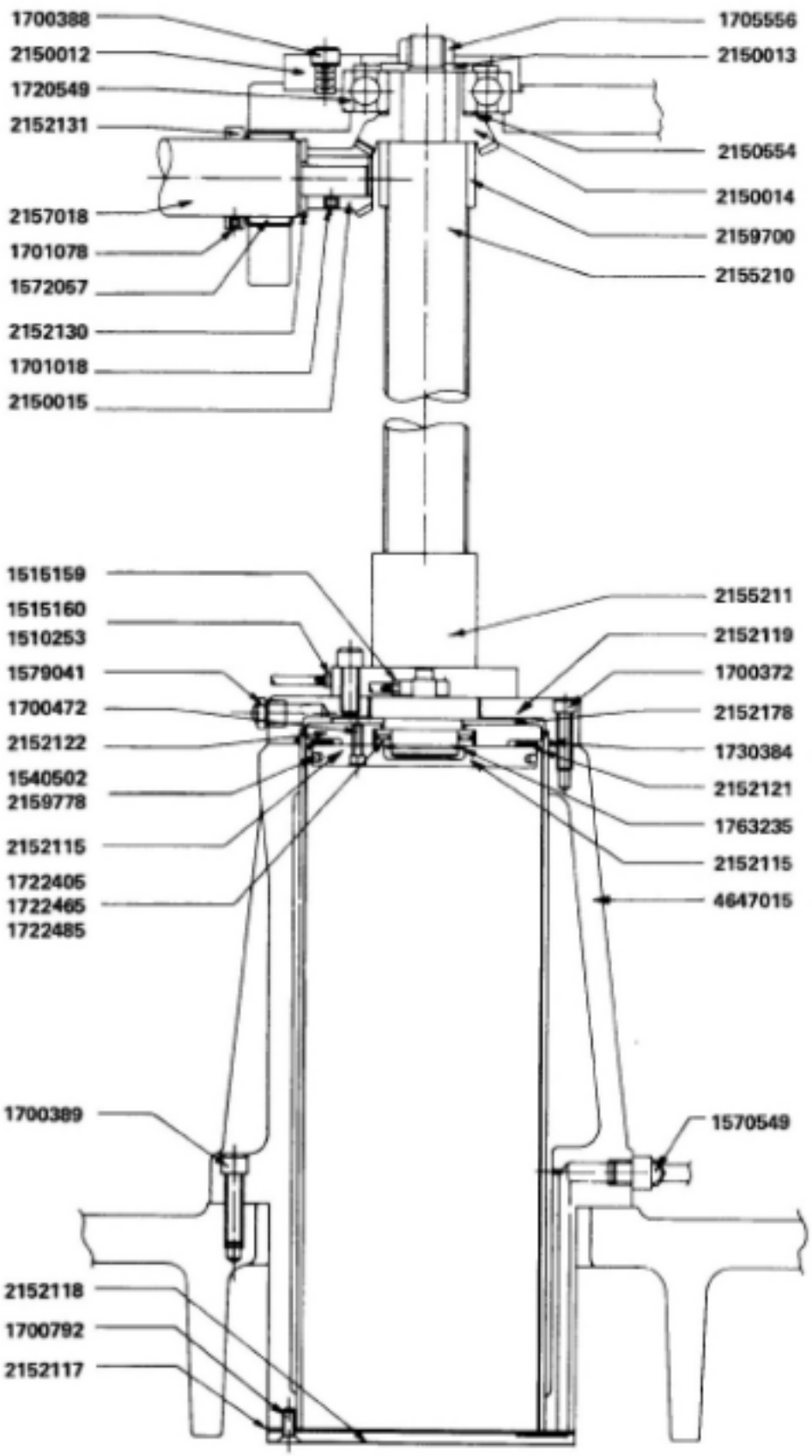
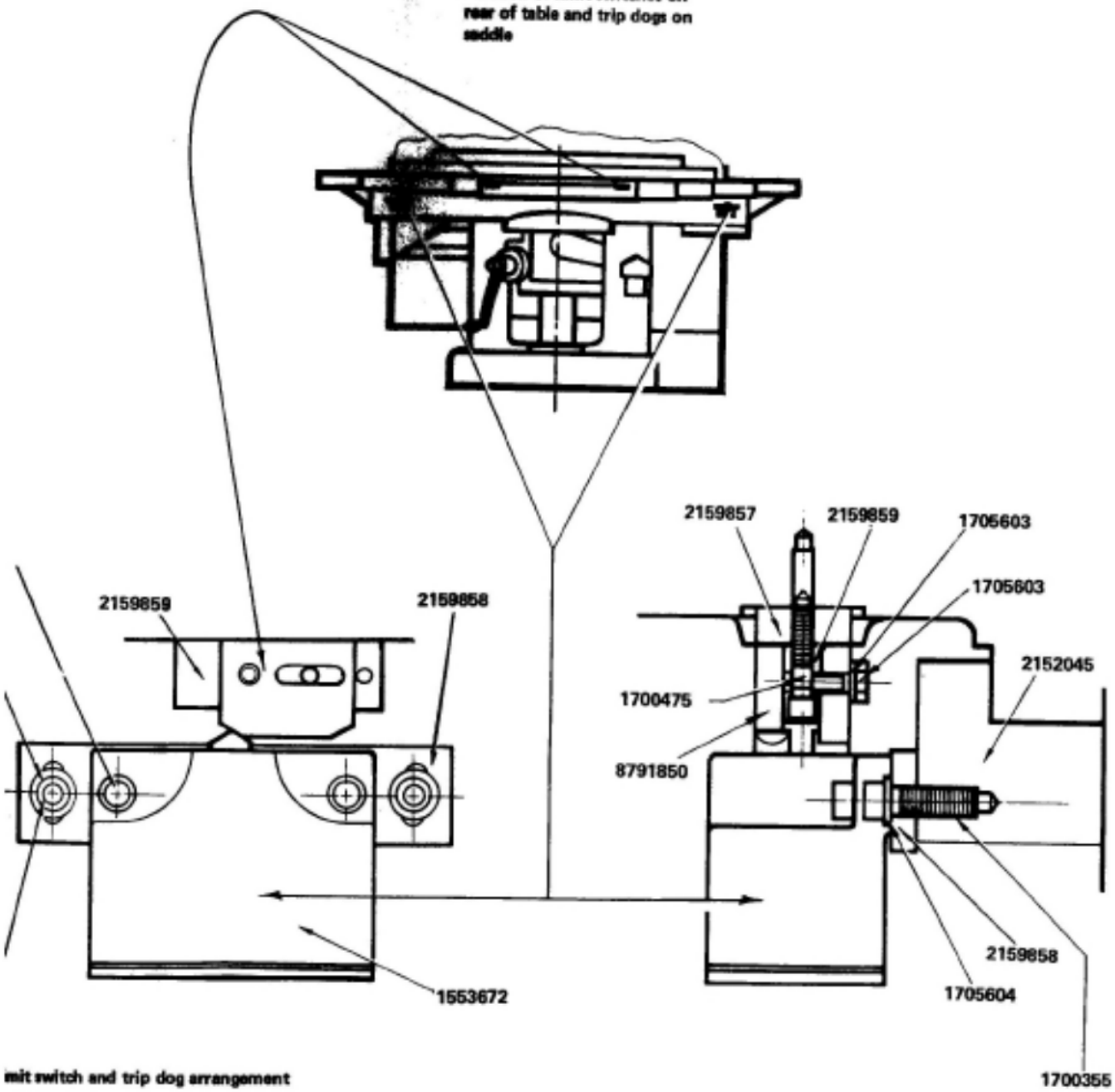


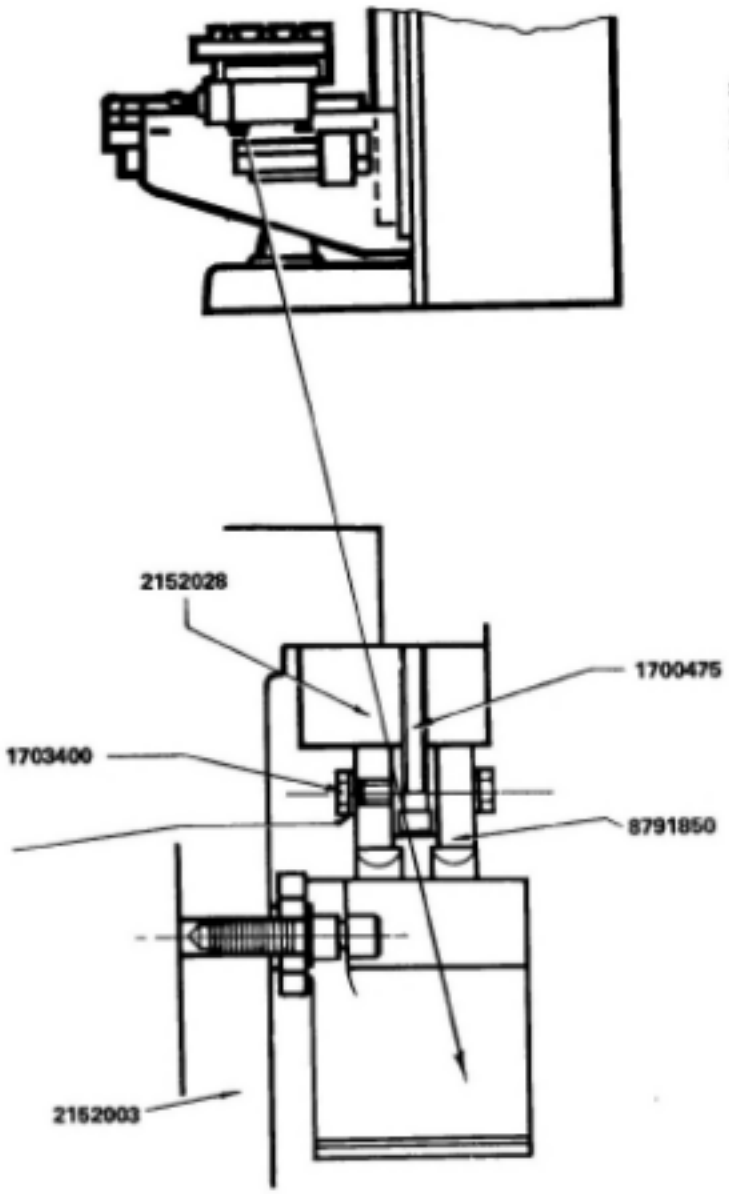
Figure 7-10 Elevating screw assembly

TION
it switch on
dogs on side

FRONT ELEVATION
Position of limit switches on rear of table and trip dogs on saddle



mit switch and trip dog arrangement



SIDE ELEVATION
Position of limit switch on saddle and trip dogs on side of knee

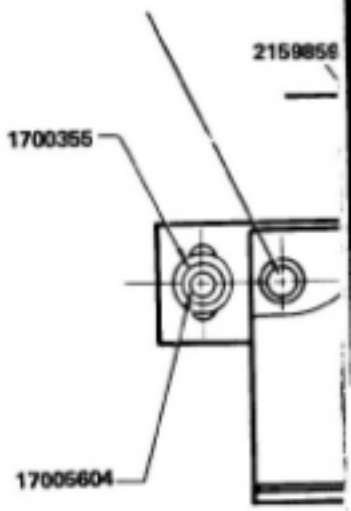
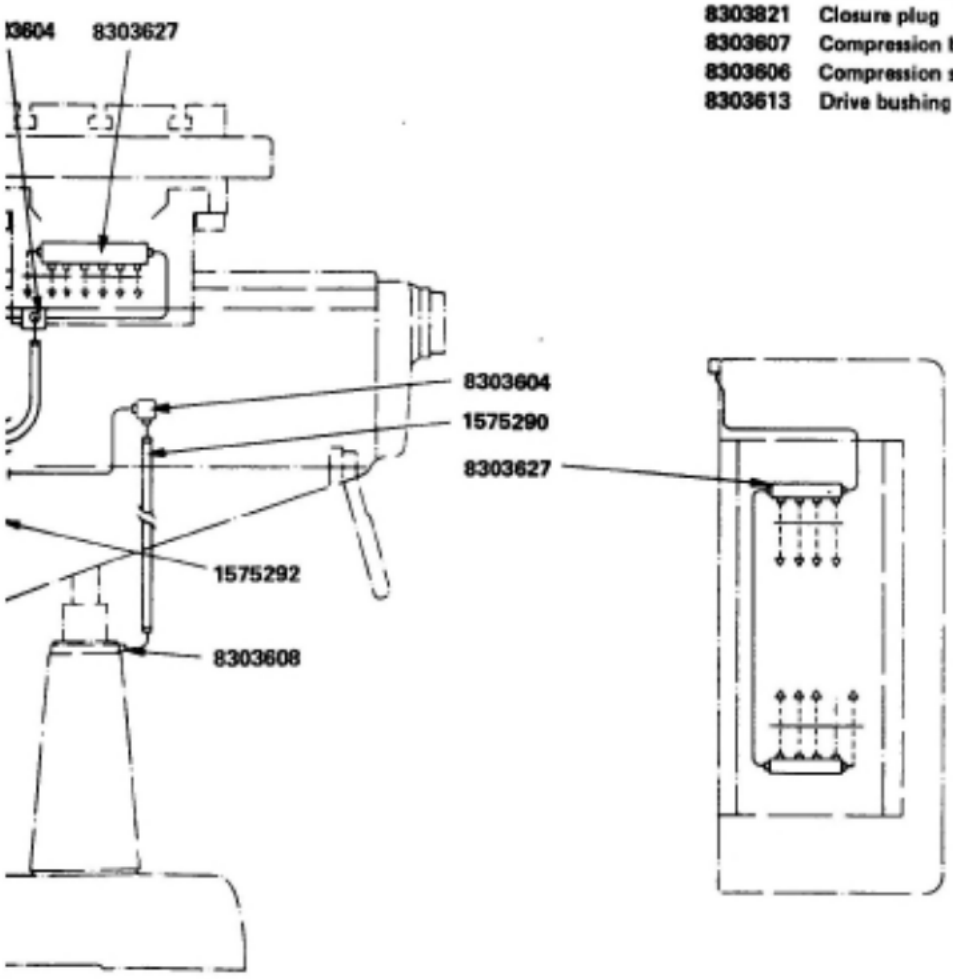


Figure 7-11 Limit switch and trip

Lubrication items not annotated

8303615	Meter unit FJB-00
8303601	Meter unit FJB-0
8303603	Meter unit FJB-1
8303628	Meter unit FJB-2
8303821	Closure plug
8303607	Compression bushing
8303606	Compression sleeve
8303613	Drive bushing



12 Knee lubrication system

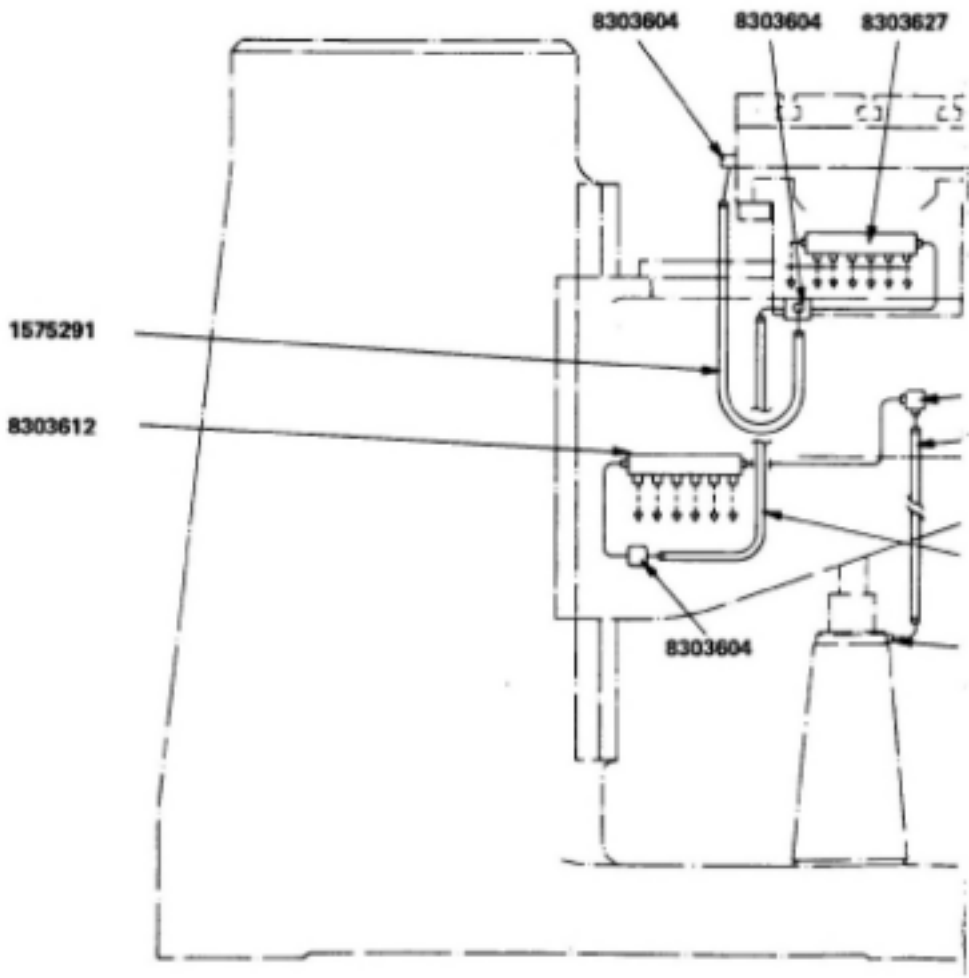
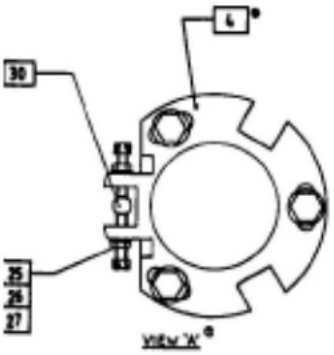
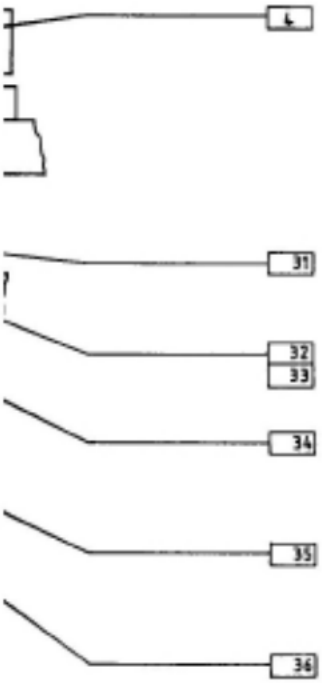
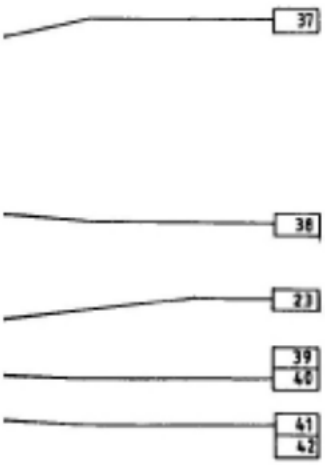


Figure 7-12 Knee lubrication :



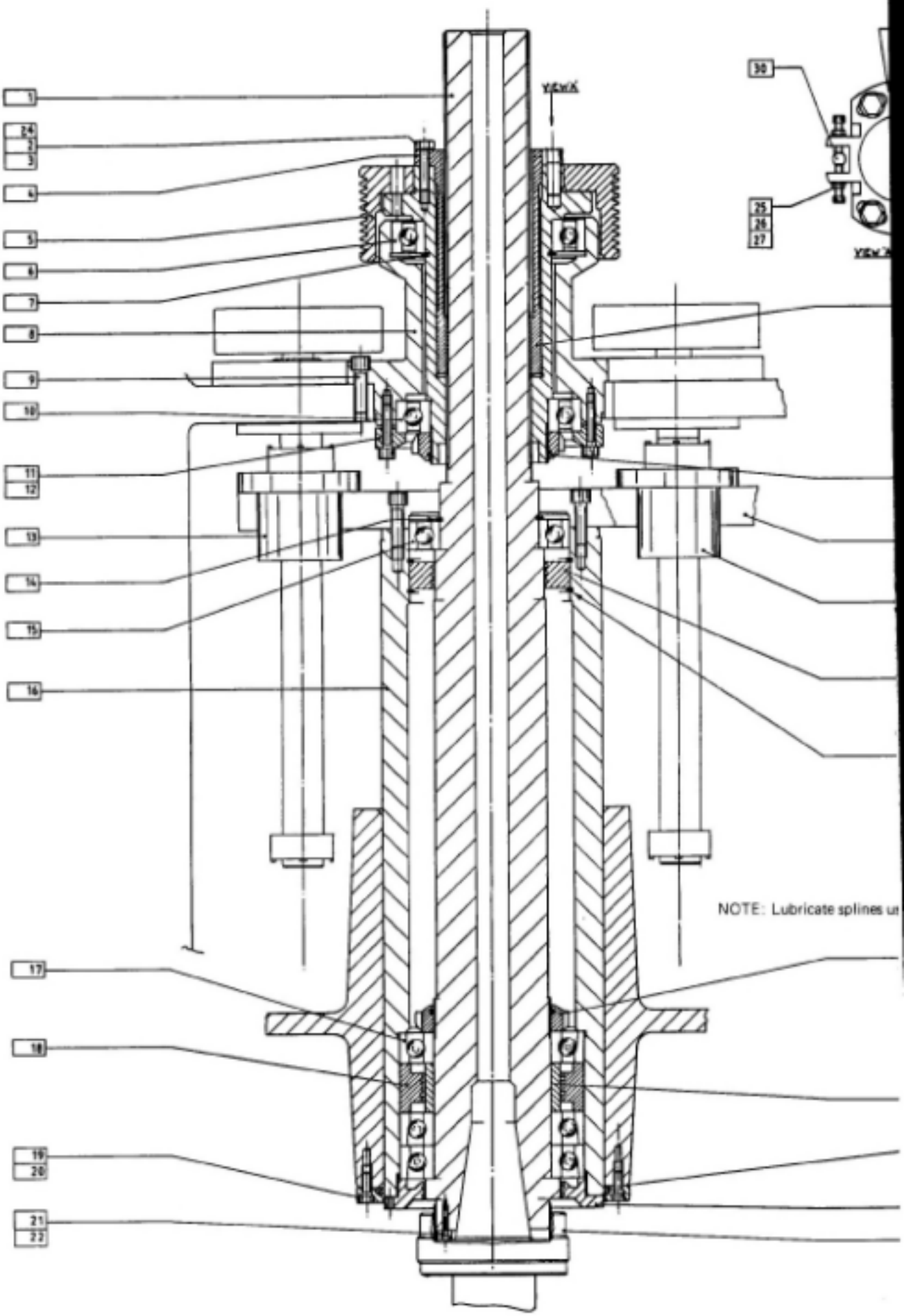


: Lubricate splines using ROCAL grease MTLM.



1	2159564	Spindle	1
2	1703182	Screw hex hd ¼" UNC x 1	3
3	1705674	Washer ¼" dia. heavy pattern	3
4	2159980	Backlash eliminator	1
5	2159965	Pulley assy.	1
6	1720056	Bearing 6015-2Z	1
7	1763075	Ext. circlip ϕ 75mm	1
8	2159926	Bearing housing	1
9	1700371	Screw hex soc cap 5/16" UNC x 1"	4
10	1720055	Bearing 6014-2Z	1
11	1700357	Screw hex soc cap ¼" UNC x 1"	4
12	2159928	Bearing cap	1
13	2159978	Ballscrew	1
14	1763060	Ext. circlip ϕ 60mm	1
15	1720624	Bearing 6012 EP7 TB	1
16	2159912	Quill	
17	1720623	Bearing set 7014 TAU EP 7 (3 per set)	
18	2159916	Spacer bearing	1
19	1700471	Screw hex soc cap 10/32 UNF x ½"	6
20	2159914	Quill cap	1
21	1579437	Drive dogs	2
22	1710030	Screw hex soc cap M4x 16	2
23	2159947	Wiper	1
24	1705758	Spring washer	3
25	1700473	SCR Skt cap 10/32 x ¾"	2
26	1705160	Locknut 10/32	2
27	1705757	Spring washer ϕ 3/16"	2
28	2159510	Cup sleeve	1
29			
30	2159539	Dowel pin	1
31	2159532	Self locking nut	1
32	2159920	Yoke	1
33	1700371	Screw hex soc cap	6
34	2159978	Ballscrew	1
35	2159917	Spacer	1
36	1763195	Circlip int. ϕ 95mm	2
37	2159532	Self locking nut	1
38	2159915	Bearing spacer	1
39	2159913	Bearing cap	1
40	1701077	Screw hex soc set 10/32 UNF 5/16"	3
41	1579430	Spindle Nose	1
42	1579438	Spanner	1

Figure 7-13 Spindle assembly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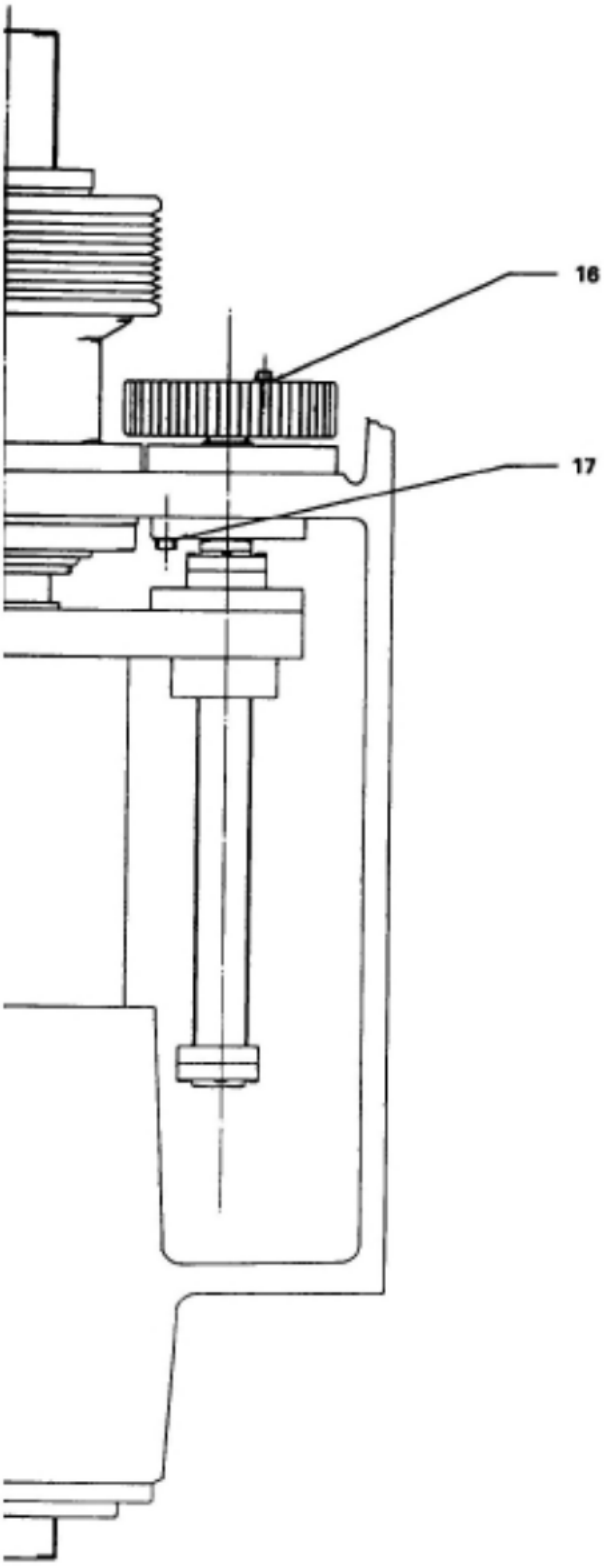
NOTE: Lubricate splines



Item	Part no.	Description	Qty.
1		Spindle assy.	1
2	2159925	Plate - pulley assy.	2
3	1700337	Screw hex soc cap no. 8 UNC x 1"	8
4	1705622	Washer 5/32 dia.	8
5	2159924	Pulley 40t	2
6	8791817	Spacer	2
7	1572732	Ring feder locking element	2
8	2159922	Housing - bearing	2
9	1700371	Screw hex soc cap 5/16 UNC x 1"	8
10	1765041	Self locking nut	2
11	1720622	Bearing BSB 020 047 DU EP7QS5B	2 pr.
12	2159923	Cap	2
13	1700371	Screw hex soc cap 5/16 UNC x 1"	8
14	2159978	Ballscrew	2
15	1700475	Screw hex soc cap 10/32 UNF x 1"	12
16	1705552	Nyltite insert	8
17	1705759	Spring washer 5/16 dia.	8

llscrew assembly

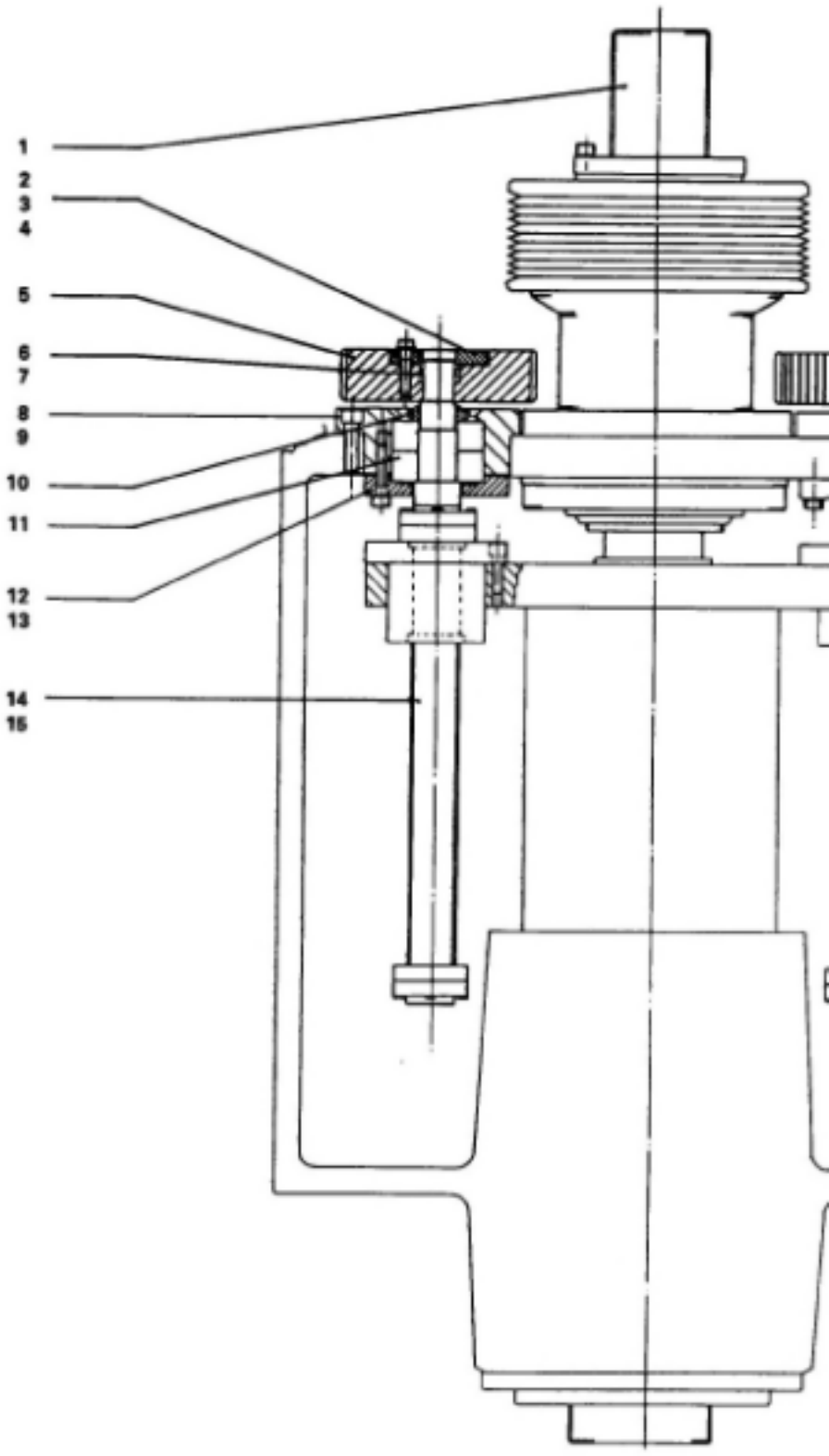
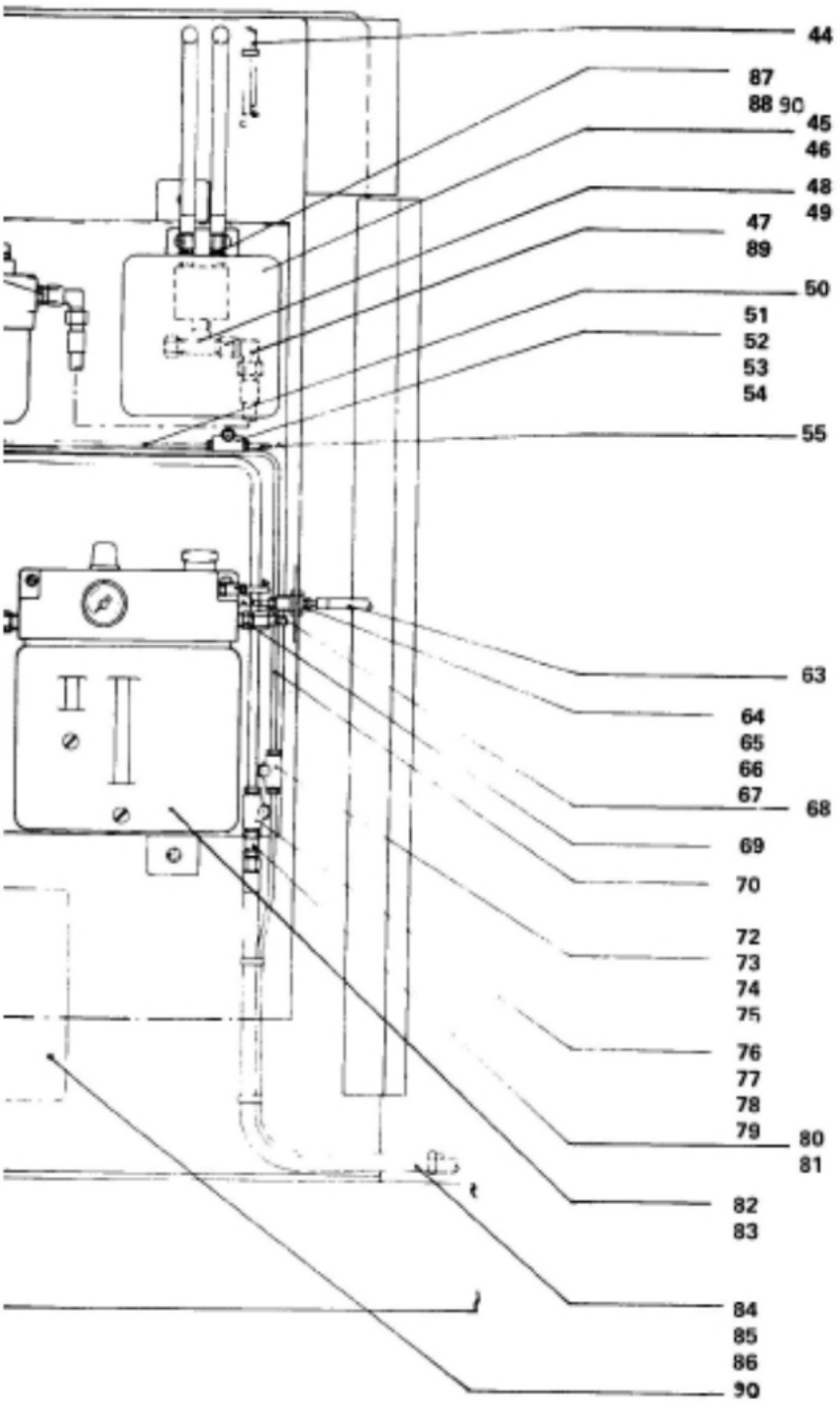


Figure 7-14 Twin ballscrew assembly



1-15 Air service panel

Item	Part no.	Description	Qty.	Unit
1	1510560	Nylon tube 4m/m	3M	STD
2	2159977	Air service panel	1	STD
3	1700309	Screw hex soc. cap 5/16 UNC x 3/4	4	STD
4	1705655	Washer 5/16 dia.	4	STD
5	2159982	Pipe – Spray mist	1	Spray mist
6	1570567	Adaptor male/male 1/4 BSP/3/8 JIC	1	I 4 option
7	1575269	Mounting bracket 18-001-990	1	STD
8	1700470	Screw hex soc. cap no. 10 UNF x 3/8	2	STD
9	1570833	Connector 4 way 34-0131-05	1	STD
10	1570628	Tubing sleeve 34-0278-05	2	Spray mist
11	1570687	Nipple adaptor 34-0350-17	2	STD
12	1570644	Tubing nut 34-0279-05	2	Spray mist
12	1570427	Tubing plug 34-0036-05	1	STD
13	8303653	Gauge 18-013-013	1	STD
14	1570777	Straight male adaptor 34-0346-17	1	STD
15	1570628	Tubing sleeve 34-0350-17	1	STD
16	1570644	Tubing nut 34-0279-05	1	STD
17	1570477	Stem elbow connector 34-0057-05	1	STD
18	1570450	Nippled adaptor 34-0351-17	1	STD
19	8303879	Shut off valve 04-0420-00-000	1	STD
20	1561770	Filter regulation B11-200-A3MD	1	STD
21	1561771	Lubricator – Micro fog L11-200-MLRD	1	I 4 option
22	2159983	Pipe – Knee assist	1	STD
23	1575224	Elbow 90° 51-2001-01	1	STD
24	8303607	Compression bushing B1371	1	STD
25	8303617	Compression sleeve B1061	1	STD
26	1579740	Gauge B5611	1	STD
27	1700470	Screw hex soc. cap no. 10 UNF x 3/8	2	STD
28	8303607	Compression bushing B1371	1	STD
29	8303617	Compression sleeve B1061	1	STD
30	1570681	Cable clip 34-0218-06	1	STD
31	1700355	Screw hex soc. cap 1/4 UNC x 3/4	1	STD
32	1575143	Junction	1	STD
33	8303607	Compression bushing B1371	4	STD
34	8303617	Compression sleeve B1061	4	STD
35	1700355	Screw hex soc. cap 1/4 UNC x 3/4	2	STD
36	2159987	Pipe – Lubrication	1	STD
37	2159985	Pipe – Gauge	1	STD
38	1570477	Stem elbow connector 34-0279-05	1	Spray mist
39	1570528	Tubing sleeve 34-0350-17	2	Spray mist
40	1570644	Tubing nut 34-0279-05	2	Spray mist
41	1570800	Straight male adaptor 34-0347-17	1	Spray mist
42	1575246	Lubrication pump LF2510	1	STD
43	1700355	Screw hex soc. cap 1/4 UNC x 3/4	2	STD
44	1515171	Dual hose B167	1	Spray mist
45	4649863	I4 option	1	I 4 option
46	1700355	Screw hex soc. cap 1/4 UNC x 3/4	2	I 4 option
47	1515169	Hose 3/8 SAE x 8"	1	I 4 option
48	1570575	Cap 3/8 JIC	1	I 4 option
49	1570552	Tee adaptor 845 FS06 x 04	1	I 4 option
50	2159988	Pipe – Knee lub	1	STD
51	1575140	Manifold	1	STD
52	8303607	Compression bushing B1371	2	STD
53	8303617	Compression sleeve B1061	2	STD
54	1700355	Screw hex soc. cap 1/4 UNC x 3/4	1	STD
55	1510560	Nylon tube 4m/m	3M	STD
63	1575291	Hubs B3533	1	STD
64	1570421	Lockfast 36-0520-01	1	STD
65	1570420	Bulkhead connector 36-0508-02	1	STD
66	1575278	Nut 4m/m	2	STD
67	1575280	Sleeve 4m/m	2	STD
68	1575275	Check valve B3815	1	Spray mist
69	1575234	Hose connector B151	1	Spray mist
70	2159984	Pipe – Auto drain	1	STD
72	1575140	Manifold	1	STD
73	8303607	Compression bushing B1371	2	STD
74	8303617	Compression sleeve B1061	2	STD
75	1700355	Screw hex soc. cap 1/4 UNC x 3/4	1	STD
76	1570692	Bracket straight connector 34-0068-05	1	STD
77	1570628	Tubing sleeve 34-0350-17	1	STD
78	1570644	Tubing nut 34-0279-05	1	STD
79	1700367	Screw hex soc. cap 1/4 UNC x 1	1	STD
80	1570450	Nippled adaptor 34-0351-17	1	STD
81	1570570	Adaptor 1/4 BSPT male 1/4 JIC male	1	STD
82	8028001	Spray mist unit HBAU 133	1	Spray mist
83	1703181	Screw hex hd 1/4 UNC x 3/4	2	Spray mist
84	1510560	Nylon tube 4m/m	3M	STD
85	1564206	Cable tie	4	STD
86	1515163	Hose 1/4 JIC x 38"	1	STD
87	1570571	Male adaptor BSP 3/4 x 04	2	I 4 option
88	1515176	Hose 72" long	2	I 4 option
89	1570568	Elbow 3/8 JIC M/F	2	I 4 option
90	8303871	Elbow 7/16 JIC (M) 1 1/8 NPT	2	I 4 option
91	1552697	Coolant pump	1	STD

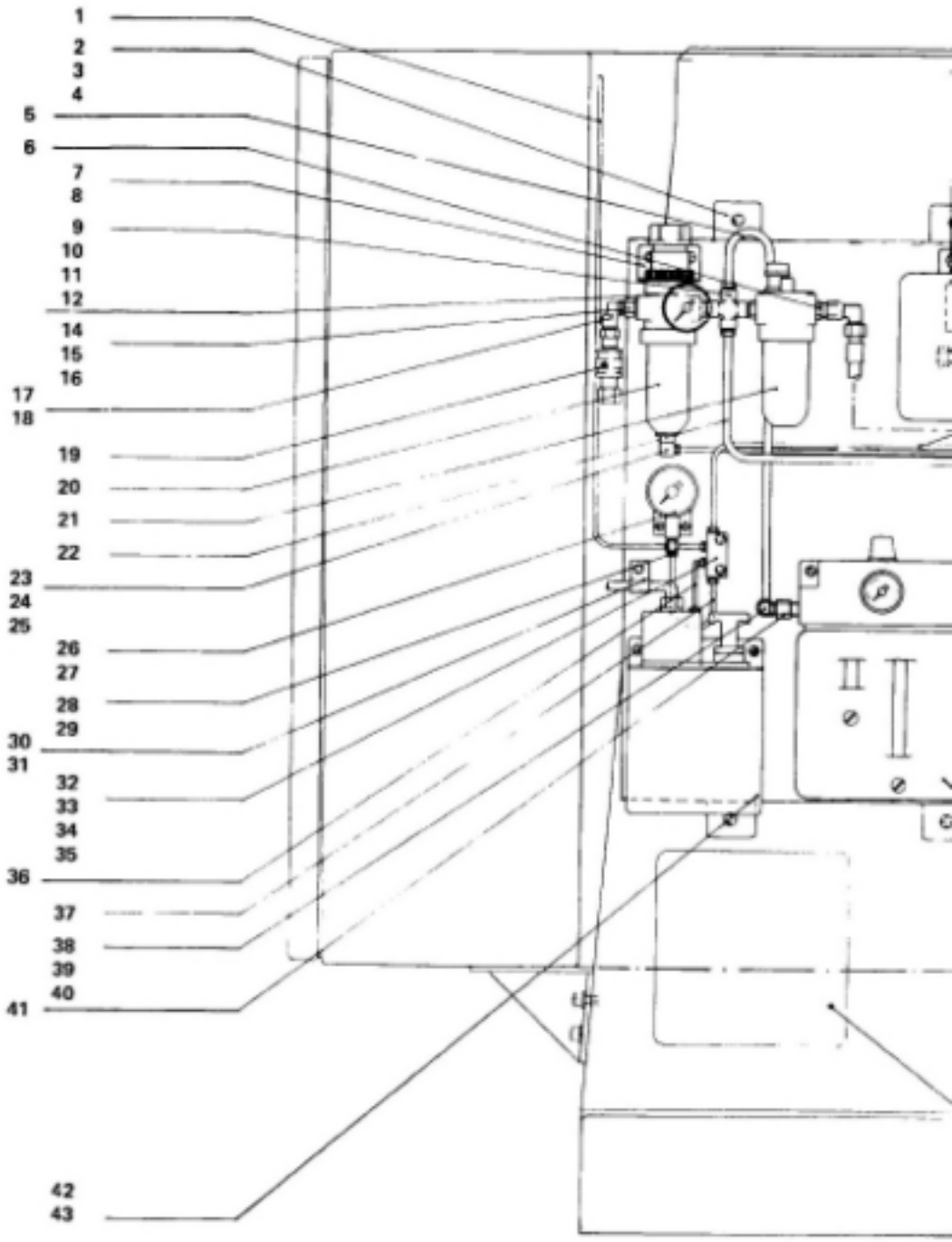
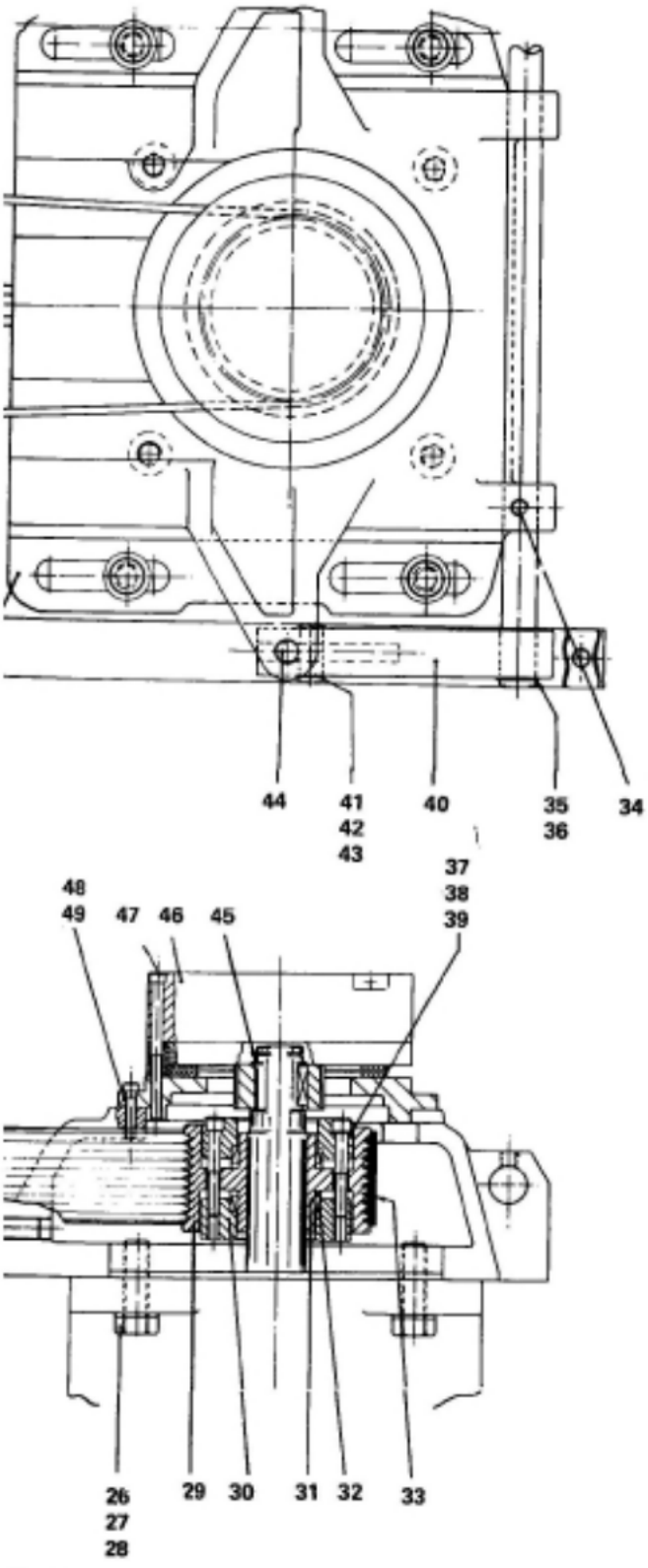


Figure 7-15 Air service pane



r/feed drive arrangement

Item	Part no.	Description	Qty.
1	215-050	Spindle assy.	1
2	1577987	Timing belt 1400-8H-20	1
3	2159930	Idler pulley	1
4	1720620	Bearings 6203 Z	pair
5	1763340	Snap ring INT. Ø40	2
6	2159931	Spigot	1
7	1700371	Screw soc. cap 5/16" UNC x 1"	3
8	1763017	Circlip ext. Ø17	1
9	1701059	Screw soc. cap 1/2" UNC x 2"	1
10	1705046	Nut 1/2" UNC	1
11	2159919	Adjuster feed motor	1
12	1700371	Screw soc. cap 5/16" UNC x 1"	4
13	2159855	Motor pulley	1
14	8791814	Pulley flange	1
15	8791815	Locking plate	1
16	1700338	Screw soc. cap 8 UNC x 1 1/4"	4
17	1705603	Washer 3/16"	4
18	1572732	Locking element ring feeder	1
19	8791817	Spacer	1
20	1551208	Motor MT30Z4-61	1
21	2159933	Motor plate	1
22	1701646	Screw soc. c/sk 5/16" UNF x 3/4	4
23	1701035	Screw soc. set 5/16" UNC x 5/8	1
24	1703261	Screw hex. hd 1/2" UNC x 2 1/2	1
25	1705046	Nut 1/2" UNC	1
26	1707812	Stud 1/2" UNC x 2"	4
27	1705046	Nut 1/2" UNC	4
28	1705678	Washer 1/2"	4
29	2159520	Motor pulley	1
30	2159522	Lock plate	1
31	2159523	Thrust ring	2
32	1572734	Locking element ring feeder	2
33	1577952	Belt poly V, 727L10	1
34	1701040	Screw soc. set 3/8" UNC x 3/8	1
35	2159937	Bar	1
36	1576011	Circlip ext. 3/4"	4
37	1700360	Screw soc. cap 1/4" UNC x 1 3/4	6
38	1705758	Washer spring type 1/4" dia.	6
39	2159521	Lock plate	1
40	2159938	Roller block	2
41	2159939	Roller pin	2
42	1763012	Circlip ext. Ø12	4
43	1722101	Roller INA RSTO 8TN	2
44	1703261	Screw soc. set 1/2" UNC x 2"	2
45	1763025	Circlip ext. Ø25	1
46	1577263	Brake matrix 1EB 45-11	1
47	1710090	Screw soc. cap M6 x 75	3
48	2159934	Brake mount	1
49	1700357	Screw soc. cap 1/4" UNC x 1	4
50	1700412	Screw soc. cap 1/2" UNC x 3/4	4
51	2159908	Washer 1/2"	4
52	2159921	Motor bracket	1
53	1700374	Screw soc. cap 5/16" UNC x 13/4	4
54	2159946	Rails	2
55	1706878	Dowel spring tension 3/8 x 2	2

NOTE: Items 32 & 37 to be lightly oiled.
Item 37 screws to be tightened with a torque of 15 NM (11 ft lbs).

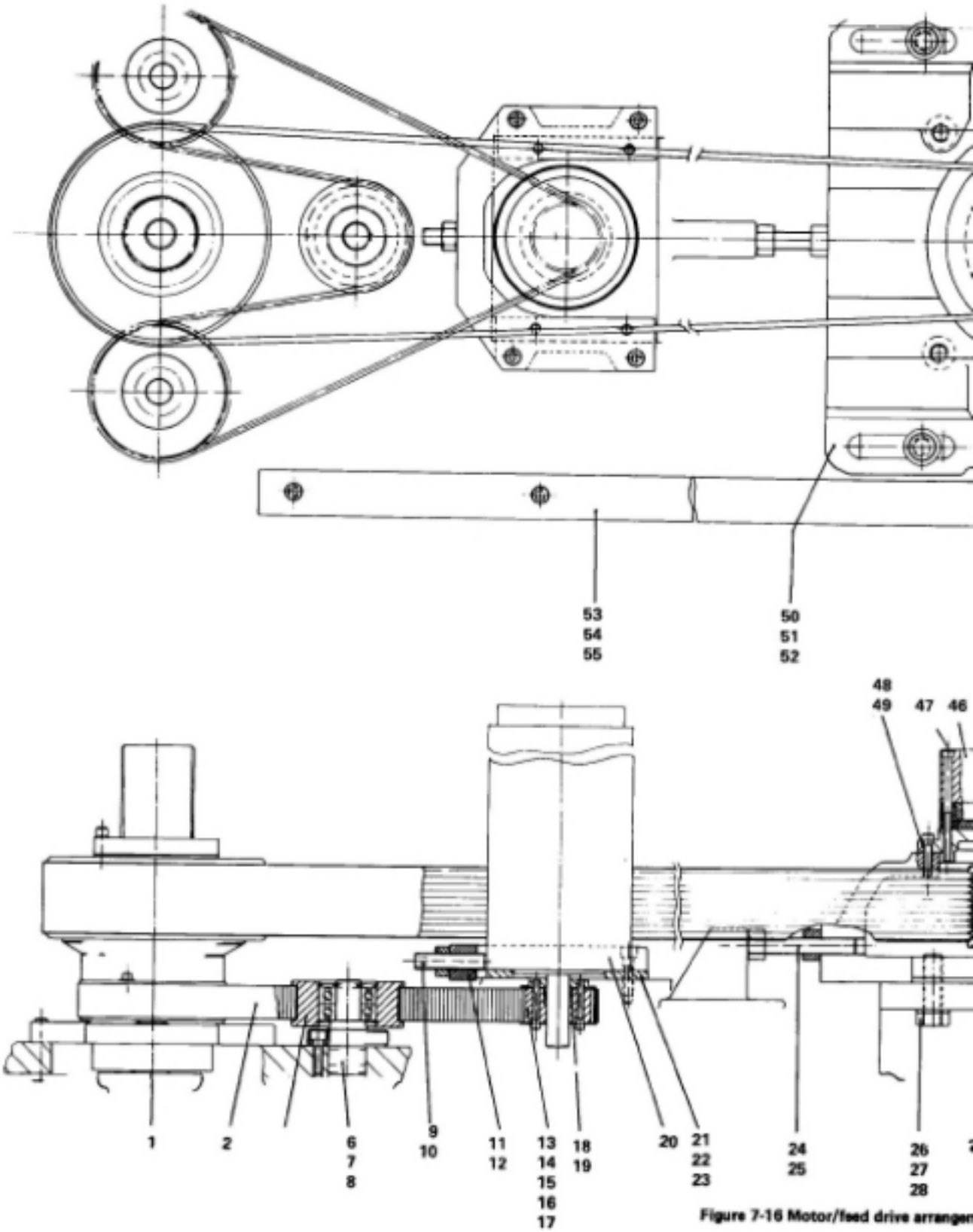
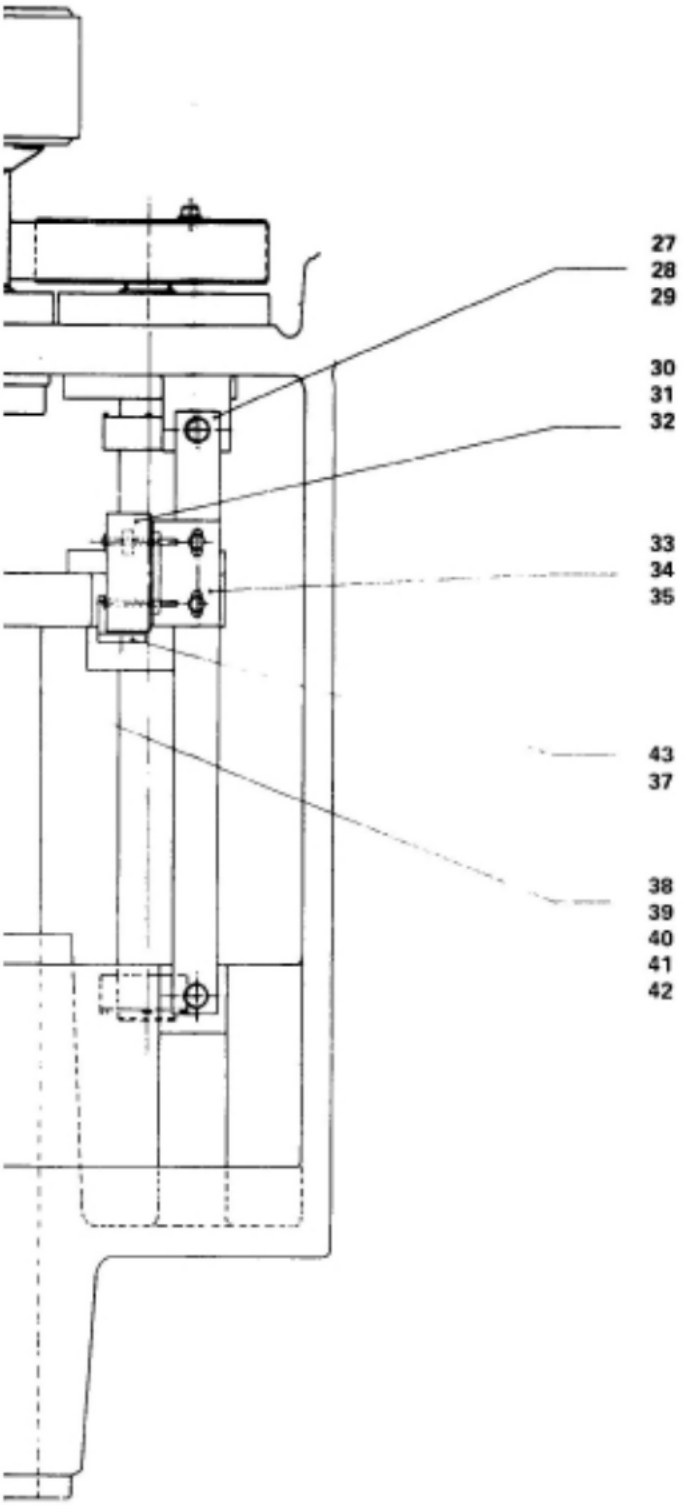


Figure 7-16 Motor/feed drive arrangen



rangement

Item	Part no.	Description	Qty.
1	2159940	Rail	1
2	2159528-31	Shim as required	
3	1700357	Screw soc. cap 1 4 UNC x 1"	2
4	2159942	Switch brkt	1
5	1700780	Screw soc cap 6 UNC x 1.2	2
6	1705622	Washer 5.32 LP	2
7	1553471	Limit switch CT7 MR3 A2	1
8	2159795	Lock plate	1
9	1701910	Screw rd. hd. 4 BA x 1 1 4	2
10	2159941	Switch stop	1
11	1700357	Screw soc cap 1/4 UNC x 1	1
12	2159943	Plate	1
13	1700357	Screw soc cap 1/4 UNC x 1	2
14	1550903	3/4 straight gland	1
15	1552015	Locknut 25 mm	1
16	1525099	3/4 anaconda	1
17	2159924	Wire guard	1
18	1700357	Screw soc cap 1/4 UNC x 1	2
19	2159942	Switch brkt	1
20	1700780	Screw soc cap 6 UNC x 1/2	2
21	1705622	Washer 5/32 LP	2
22	1553471	Limit switch CT 7 MR3 A2	1
23	2159795	Lock plate	1
24	1701910	Screw rd. hd. 4 BA x 1 1/4	2
25	1734317	Tubing clip	1
26	1700471	Screw soc cap 10/32 UNF x 1/2	1
27	2159940	Rail	1
28	2159528-31	Shim as required	
29	1700357	Screw soc cap 1/4 UNC x 1	2
30	1553471	Limit switch CT7 MR3 A2	2
31	2159795	Lock plate	1
32	1701912	Screw rd. hd. 4 BA x 2	2
33	2159942	Switch brkt.	1
34	1700780	Screw soc cap 6 UNC x 1/2	2
35	1705622	Washer 5/32 LP	2
36	2159204	Switch strip	1
37	1700352	Screw soc cap 1/4 UNC x 3/8	2
38	8303608	Elbow 90°	1
39	8303028	Meter unit i2I	1
40	1510550	Nylon pipe 4 mm	
41	8300617	Sleeve 4 mm	1
42	1575200	Nut	1
43	2159205	Trip dog (standard)	1

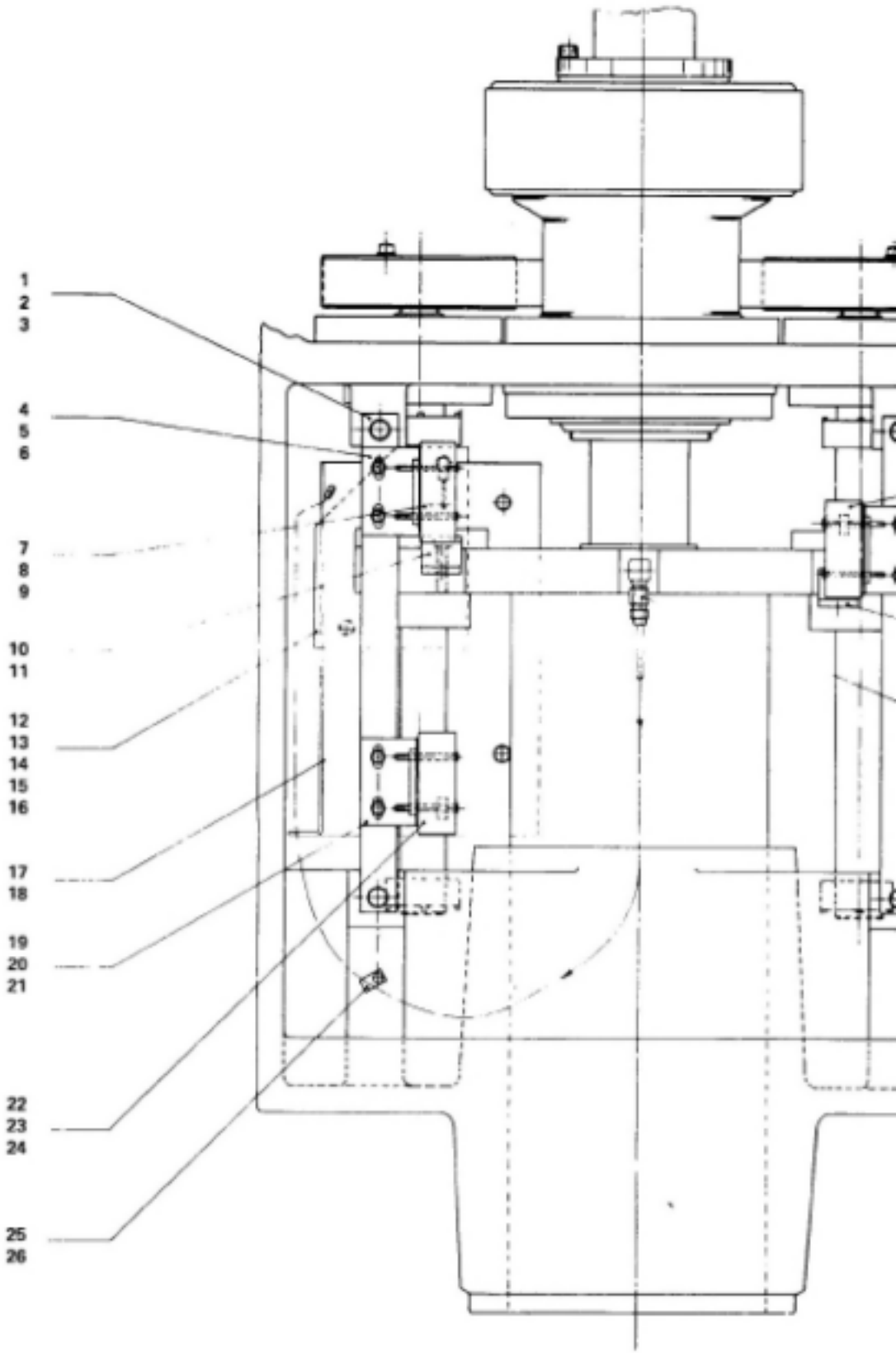
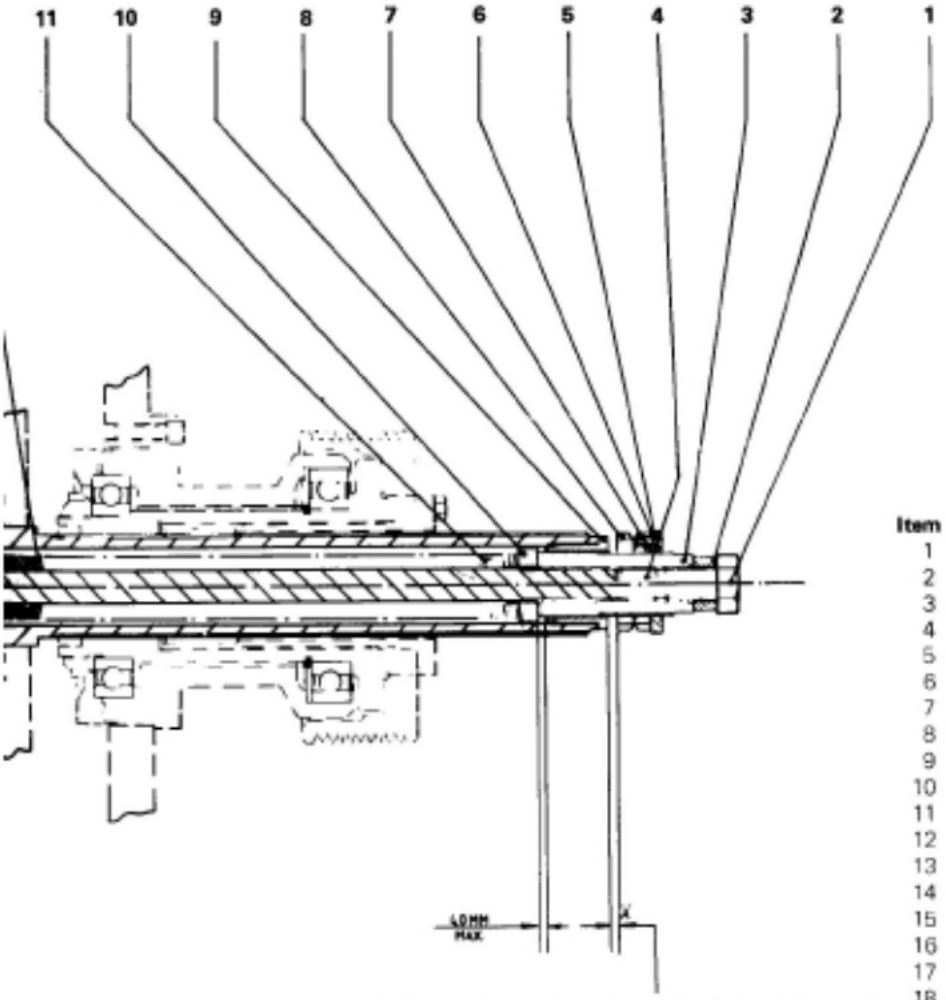


Figure 7-17 Z axis limit switch arrangement



DIM. A:– Set to zero when collet is just fully open
(5mm NOM. TOOL CLAMPED)
(9mm NOM. NO TOOL).

Item	Part no.	Description	Qty.
1	1703300	Screw hex hd 5/8 UNC x 1	1
2	2159588	Spacer	1
3	2159557	Drawbar nut	1
4	1701062	Screw skt set 5/8 UNC x 5/8	1
5	2159558	Switch disc	1
6	2700780	Screw skt csk no. 6 UNC 1/2	2
7	2159587	Switch disc holder	1
8			
9	2159555	Retaining bush	1
10	2159553	Spacer	1
11	1578107	Disc spring	120
12	1578107	Disc spring	
13	2159553	Spacer	1
14	2159563	Spacer	1
15	2159554	Spacer	1
16	2159559	Drawbar	1
17	2159556	Spacer	1
18	1579450	Collet SSK 40 ANSI	1
19	2159551	Collet sleeve	1
20	2159552	Spacer	1
21	2159550	Bearing cap	1
22	2159565	Spindle	1
23	2159562	Drive key	2
24	1700355	Screw skt cap 1/4 UNC x 3/4	2
25	1579451	Stud draw AZB 40 ANSI	

indle arrangement power drawbar

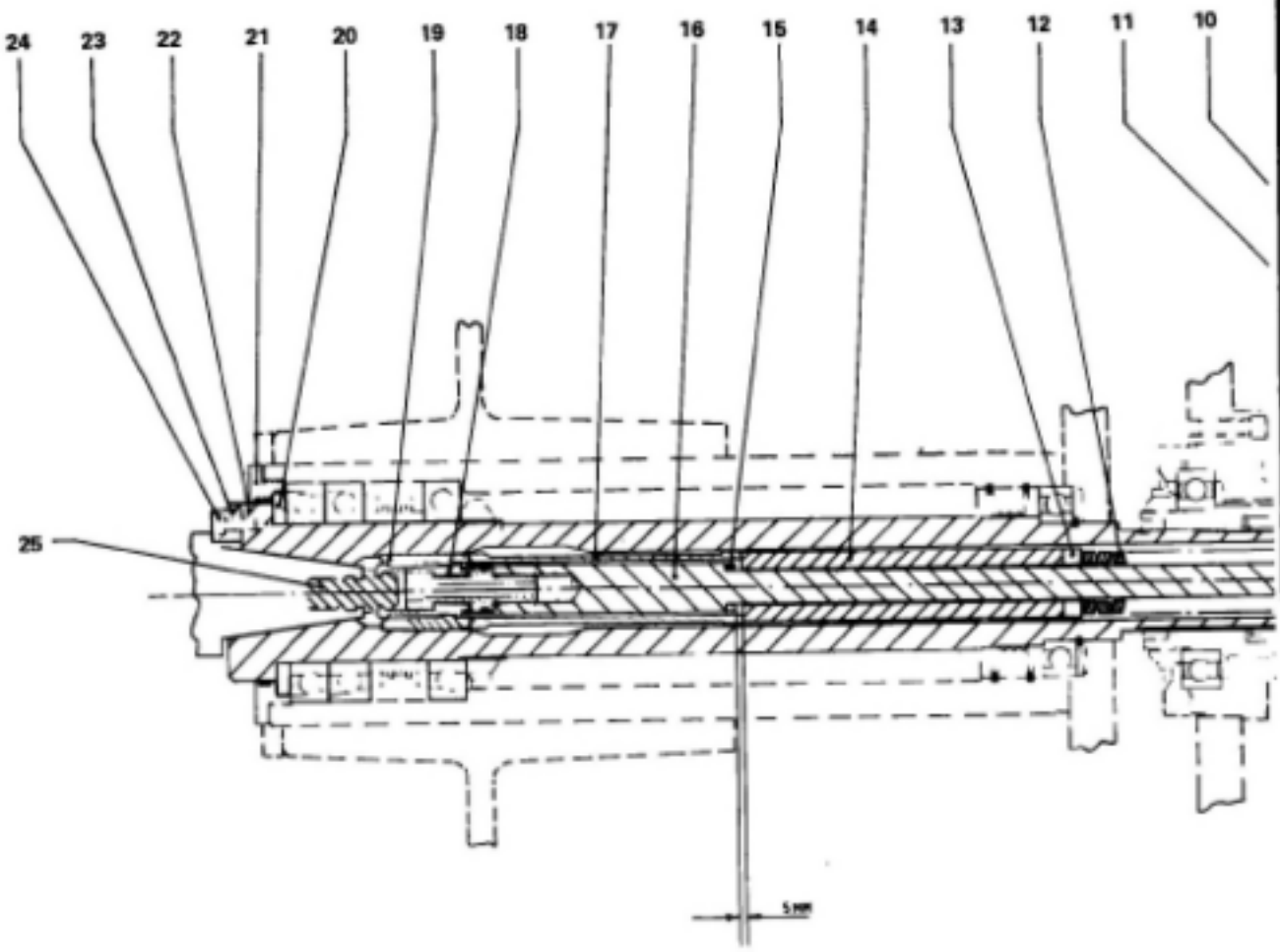
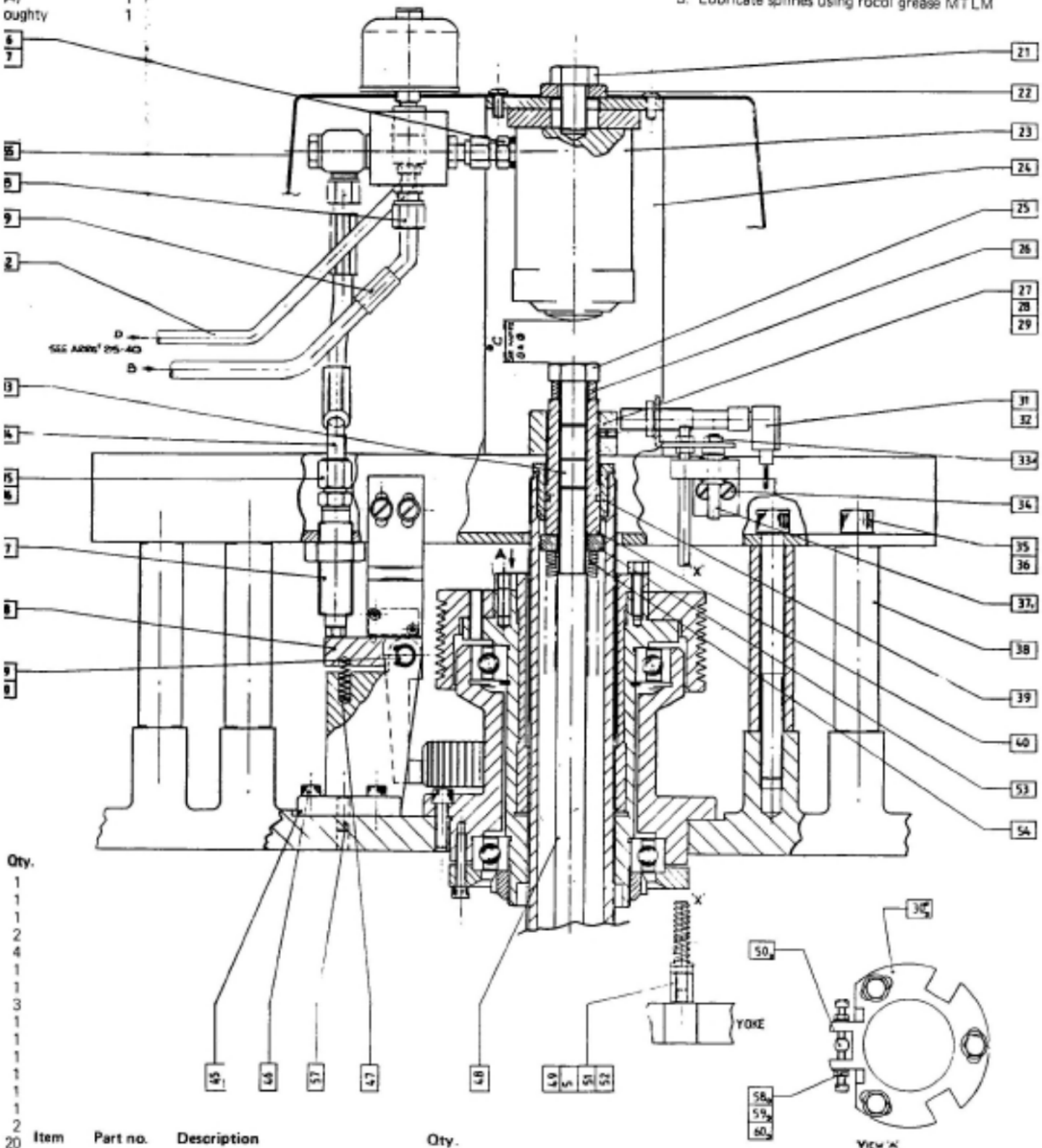


Figure 7- 18 Spindle arrangement p

NOTES:–

1. Dimension 'C' to be geared upto 1mm ±0.4 using spacer Item 26 (2159588) under the following conditions:–
   (a) The drawbar in its toolout position
   (b) The quill to be up against its top bump stop
2. When gearing up ensure that the faces of spacer 2159588 are parallel to within 0.001"
3. Lubricate splines using rocol grease MTLM

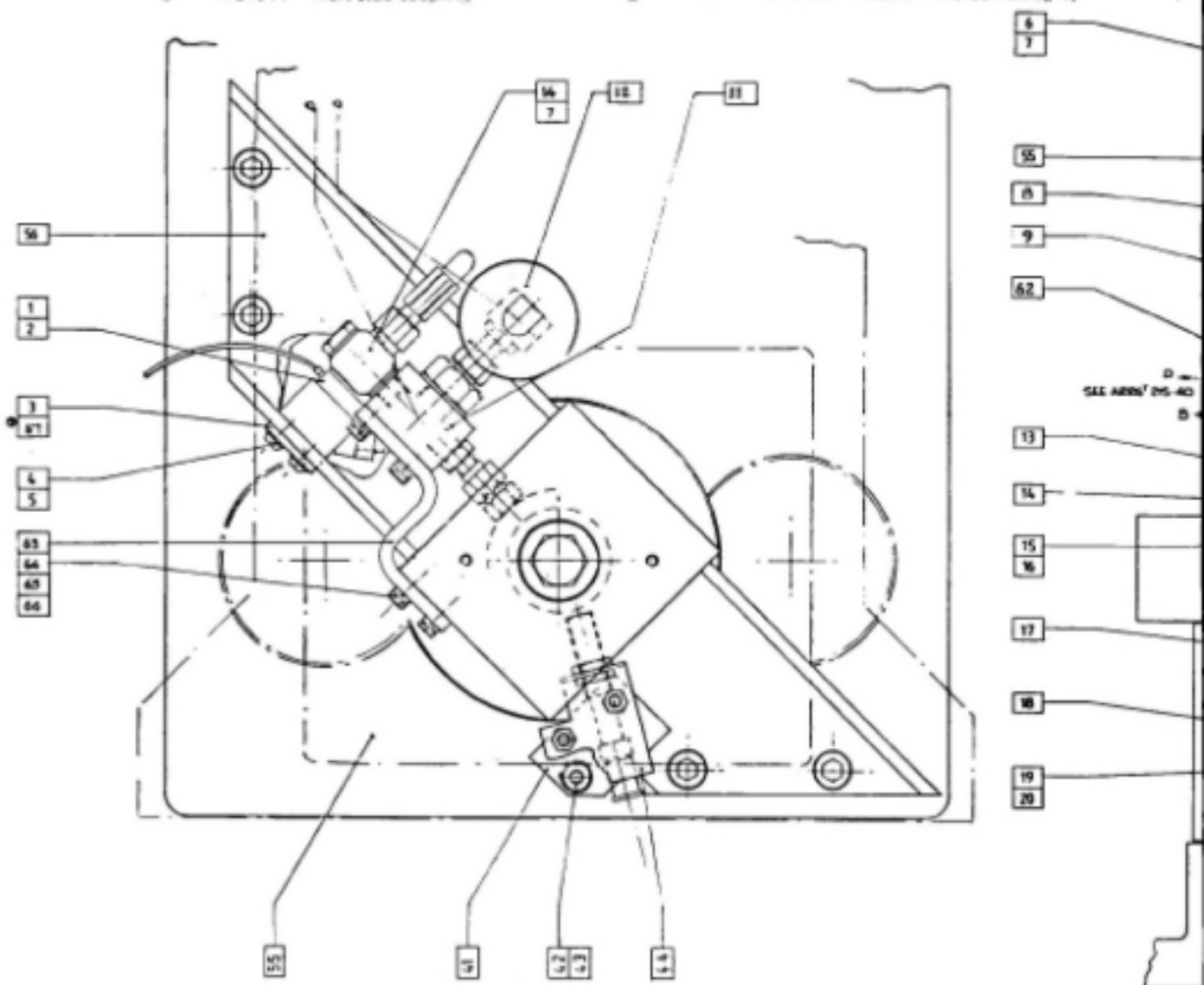


Item	Part no.	Description	Qty.
62	1510554	Nylon tube ϕ8	3M
63	2159308	Bracket	1
64	1700353	Scr. skt cap hd	4
65	1705604	Washer 1/4" dia	4
66	1705758	Spring washer 1/4" dia	4

*Modified Assembly

Figure 7- 19 Power drawbar arrangement

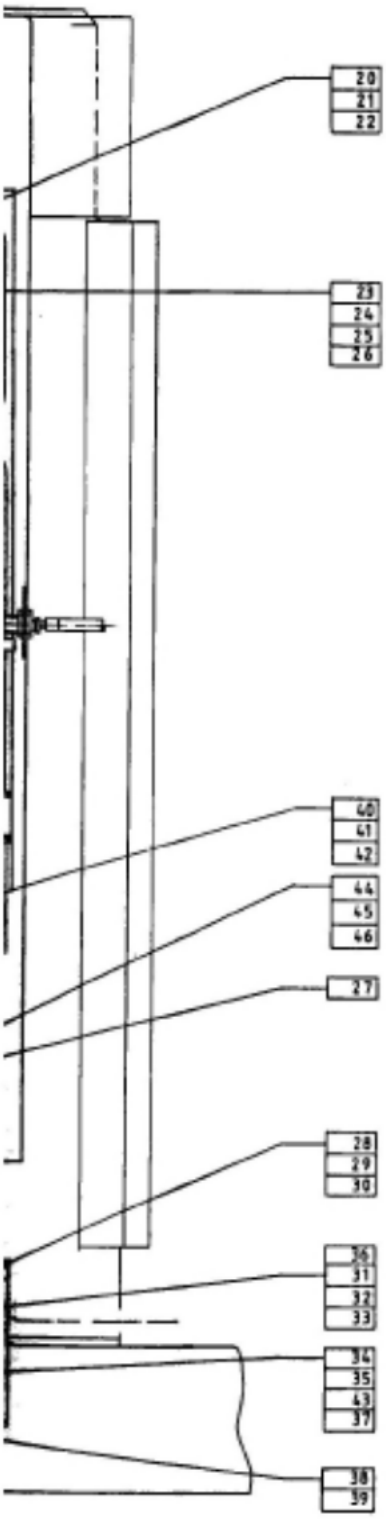
Item	Part no.	Description	Qty.
1	1553495	Micro switch 371/25/10	1
2	1710005	Screw skt cap M3 x 16	2
3	2159590	Mounting plate	1
4	1702493	Screw slotted pan 1/4 UNC x 1/2	4
5	1705604	Washer 1/4 dia	2
6	1734059	Stud stand pipe 1/4 BSP	1
7	1730101	Washer 1/4 BSP Doughty	1
8	1734014	Male stud coupling	2
9	1515186	3/8 RIT 3M	1
11	2159307	Adaptor block	1
12	1571036	Booster reservoir assy 4957	1
13	1701062	Screw skt set 5/8 UNC x 5/8	1
15	1515187	1/4 RIT 220mm	
		(X –10 Mose 455-04)	1
		(X –104 BKMG-04)	1
16	1730100	Washer - 1/8 BSP Doughty	1



Item	Part no.	Description	Qty.
17	1571030	Microram 5320	1
18	2159546	Lock lever	1
19	2159547	Pivot pin	1
20	1576005	Circlip ext 3/8	2
21	1711125	Screw hex hd M16 x 25	1
22	2159561	Washer	1
23	1571031	Powram 3550	1
24	2159544	Cylinder bkt	1
25	1703300	Screw hex hd 5/8 UNC x 1	1
26	2159588	Spacer	1
27	2159558	Switch disc	1
28	2159587	Switch disc holder	1
29	1577713	Locknut 1 1/4	1
30	2159980	Backlash eliminator	
31	1550004	Prox switch EGT 12-02AP024-SEM4	1
32	1550005	Plug prox switch SEF3P-5000	1
33	1705162	Locknut 1/4 UNF	6
34	1702493	Screw slot pan hd 1/4 UNC x 1/2	2
35	1700423	Screw skt cap 1/2 UNC x 5 1/2	4
36	1705762	Washer - spring 1/2 dia	4
37	2159301	Rod	2
	2159545	Spacer	4

Item	Part no.	Description	Qty.
39	2159555	Retaining bush	1
40	2159557	Drawbar nut	1
41	2159583	Support block	1
42	1720593	Ball bushing A4812	2
43	1576007	Circlip ext 1/2	4
44*	2159300	Switch bkt	1
45	2159560	Pivot block	1
46	1701036	Screw skt cap 5/16 UNC x 3/4	3
47	1571702	Spring Entex 20	1
48	2159559	Drawbar	1
49*	2159303	Collar	1
50	215939	Dowel pin	1
51*	2159302	Push rod	1
52	1575927	Spring Entex 57	1
53	2159553	Spacer	2
54	1578107	Disc spring	120
55	2159595	Cover	1
56	2159594	Drive cover	1
57	15450510	Dowel 1/4 dia x 3/4 lg	2
58	1700473	Scr Skt Cap 10-32 x 3/4	2
59	1705160	Locknut 10-32	2
60	1705757	Spring washer	2
61	1712150	M3 Hex washer	2

Item	Part no
62	151056
63	215930
64	170035
65	170560
66	170575



Item	Part no.	Description	Qty.	
1	1510504	Nylon tubing 5/16" dia.	1	
2	1570695	Adaptor 34-0348-17	1	Enots
3	1570644	Tubing nut 34-0279-06	1	Enots
4	1570628	Tubing sleeve 34-0278-05	1	Enots
5	1570592	Plug 1/4 BSP 34-0278-02	1	Enots
6	1570971	Seal 1/4 BSP 48-0215-02	1	Enots
7	1570350	Solenoid valve 1001/H/24 v d.c.	1	Univer
8	1570356	Sub plate L160 1/4 G	1	Univer
9	1710052	Screw hex soc cap M5 x 12	2	
10	1570592	Plug 1/4 BSP 34-0272-02	1	Enots
11	1570971	Seal 1/4 BSP 48-0215-02	4	Enots
12	1579041	Breather vent	1	
13	1570695	Adaptor 34-0348-17	2	Enots
14	1570644	Tubing nut 34-0279-05	2	Enots
15	1570628	Tubing sleeve 34-0278-05	2	Enots
16	1561775	Regulator R11-200 RNH	1	Norgren
17	1575269	Bracket 18001990	1	Norgren
18	1710052	Screw hex soc cap M5 x 12	2	
19	8303653	Gauge 18-013-989	1	Norgren
20	1570695	Adaptor 34-0348-17	1	Enots
21	1570644	Tubing nut 34-0279-05	2	Enots
22	1570628	Tubing sleeve 34-0278-05	2	Enots
23	1570696	Adaptor 34-0336-17	1	Enots
24	1570567	Adaptor Male/Male 1/4 BSP 3/8 JC	1	
25	1570689	Adaptor 34-0351-17	1	Enots
26	1510504	Nylon tubing 5/16 o/dia		
27	1571034	Booster 2620	1	Spencer/Franklin
28	2159591	Bracket	1	
29	1707828	Stud 3/8 UNC x 2 1/4 105-47	2	WDS
30	1705144	Nut hex 3/8 UNC	4	
31	1570697	Adaptor 34-0346-25	1	Enots
32	1570644	Tubing nut 34-0279-05	3	Enots
33	1570628	Tubing sleeve 34-0278-05	3	Enots
34	1570697	Adaptor 34-0346-25	1	Enots
35	1570477	Stem elbow 34-0057-05	1	Enots
36	1579311	Quick exhaust valve 3340B	1	Schrader
37	1579301	Muffler 476	1	Schrader
38	1703218	Screw hex hd 3/8 UNC x 1"	3	
39	1505606	Washer 3/8 dia.	5	
40	1734208	Sleeve 36-0302-06	1	
41	1734264	Adaptor 36-0304-20	1	
42	1734214	Tubing nut 36-0300-06	1	
43	2159534	Pipe	1	

re 7-20 Power drawbar option

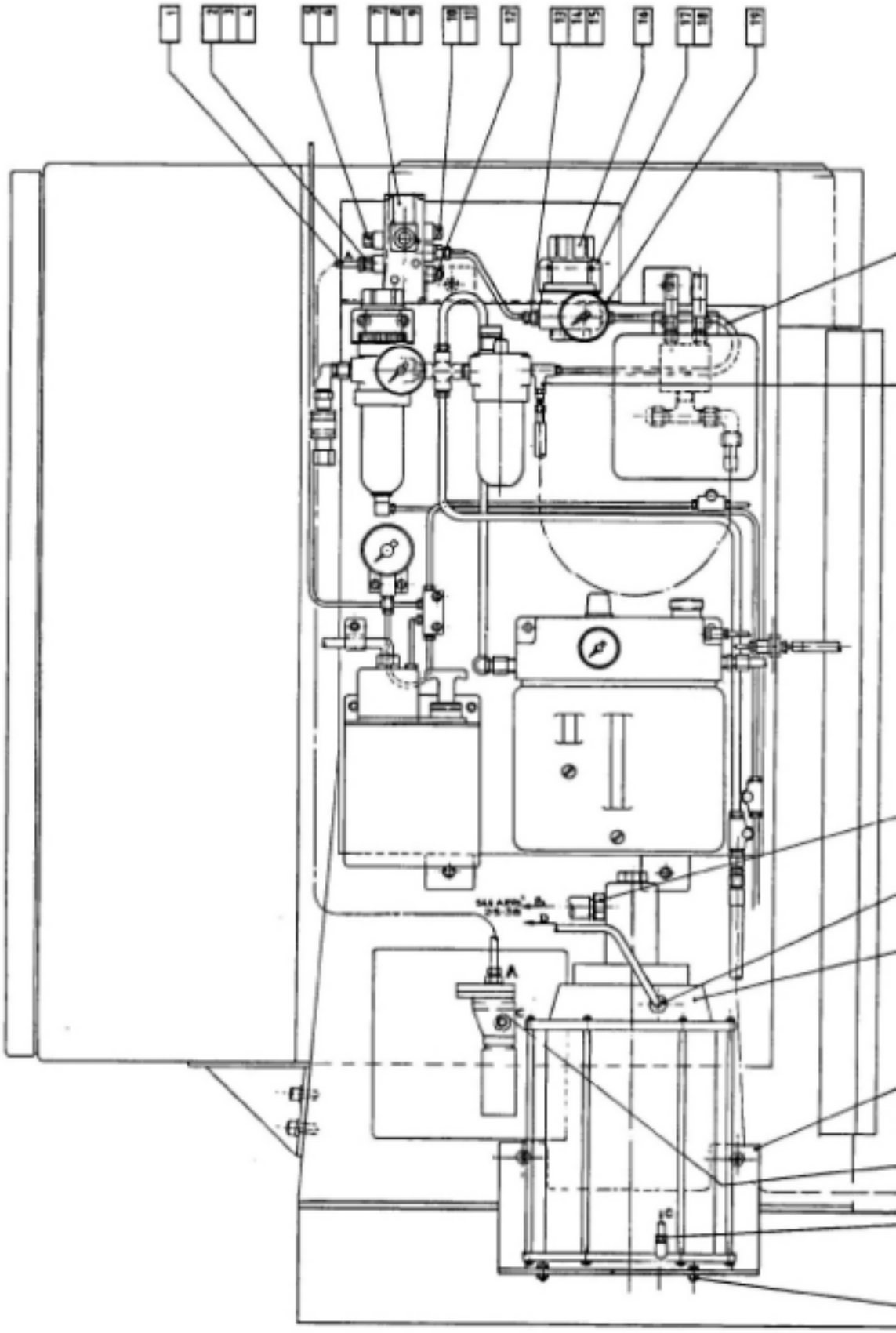
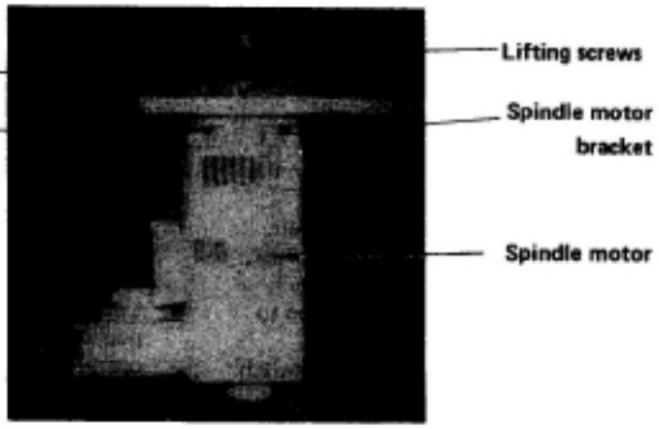


Figure 7-20 Power draw

8.SERIES II INTERACT 4-HEAD MAINTENANCE

8.1 SPINDLE MOTOR

i) Remove machine back and top cover.
ii) Remove tension from spindle drive belt by releasing adjusting screw.
iii) Locate the spindle motor and remove four cap head screws locking the spindle motor bracket.
iv) Turn each of the grub screws (lifting screws) in a clockwise direction to lift the motor bracket on to the rails.
v) Push the motor forward towards the front of the machine.
vi) Remove multi 'V' belt from spindle motor pulley and spindle pulley.
vii) Push motor back against dowel stops on rail.
vii) After disconnecting or replacing the 'V' belt, re-set the tension as follows:
   a) With the belt completely slack, mark two lines 500.0 mm apart on the back of the belt. Tighten the belt, by jacking out the motor carrier, until the two lines are 503.0/503.5 mm apart. Clamp the motor carrier and check that the belt tension is correct.

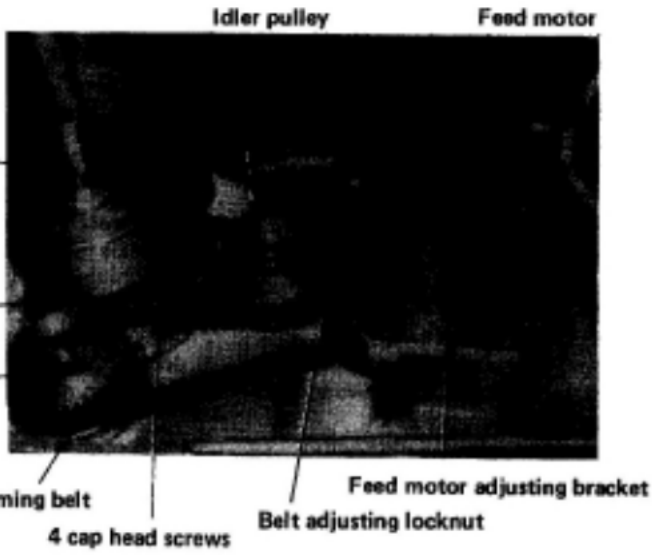


8.2 SPINDLE/QUILL REMOVAL (DAMPER SETTING)

i) Move table to its upper limit and to its –ve limit.
ii) Position block of wood on table.
iii) Place drawbar through spindle and/or attach eye bolt at upper end.
iv) Take the weight of the spindle via cranage.
v) Using 'T' wrench, unscrew cap head screws which secure yoke to quill
vi) Remove yoke/quill six securing screws. Lower table by the elevating handle to clear the spindle from the quill bore.

CAUTION:
Fully support the spindle to avoid bruising of the quill or quill bore. Immediately wrap the quill in lint free cloth (or similar) for added protection.

vii) Re-assemble in reverse order.
viii) If after re-assembly spindle spline rattle or quill feed 'groan' is evident, adjust the damper pressure as follows:
   a) Spline rattle – reduce shim thickness.
   b) Quill groan – increase shim thickness.



8.3 FEED MOTOR AND BELT CHANGE

i) Remove tension from feed motor drive belt by releasing adjusting screw.
ii) Slacken four cap head screws on the feed motor adjusting bracket.
iii) Move motor forward, remove belt.
iv) Re-assembly will be in reverse order. After re-assembly:
   a) Set the quill feed belt tension to eliminate any slack.
   b) Adjust the Z axis reference switch as per Section 8.5.2.
   c) Reset the Z axis software limits as per Section 8.5.3.

8.4 BALLSCREW REMOVAL AND RESETTING

i) Remove tension from feed motor belt by releasing adjusting screw, remove belt from pulley.
ii) Remove four cap head screws from feed pulley, plate and ring feeder locking element.
iii) Remove feed pulley.
iv) From bearing housing remove four hex socket cap screws.
v) From the ballscrew nut remove six hex socket cap head screws and pull ballscrew assembly out.
vi) Re-assemble both ballscrews in reverse order. After re-assembly:
   a) Re-set the Z axis software limits as per Section 8.5.3.

8.5 QUILL LIMIT SWITCHES

8.5.1
Z axis extreme limit switches

The available stroke of the quill is determined by the software limits set in the machine control. The extreme limit dogs exist only as an additional safeguard to shut off power to the axis drive in the event of a control or drive malfunction which causes the quill to go outside its software limits.

i) In order to set the extreme limit switches it is necessary to override the software limits.
   Change machine parameter 48 to +1000
   Change machine parameter 49 to -1000

CAUTION:
The Z axis software limits are now inactive. Use the handwheel only. Approach the bump stops at a creep feed rate.

ii) Lower the quill approximately 25 mm.
iii) Remove three screws from the hinged front housing (2159952) to give access to the limit switches.
iv) Carefully using the handwheel (and power enable button to override the extreme limit switch) raise the quill to its mechanical limit and note the DRO reading.
v) Lower the quill 6 mm and set the positive limit switch (1553471) to operate at this position.
vi) Carefully, using the handwheel, DRO and power enable button, set the bottom limit switch (1553471) to give a stroke of 151 mm to 152 mm.
vii) Reset the Z axis reference dog as per Section 8.5.2.
viii) Reset the Z axis software limits as per Section 8.5.3.

8.5.2
Z axis reference switch

The axis reference switch is used in conjunction with the encoder on the motor shaft to determine the machine datum following an interruption of mains power.

i) When resetting the reference switch first temporarily set it to operate between 8 mm and 10 mm from the top position switch.
ii) Switch **OFF** the machine isolator. Switch **ON** the machine isolator and pass over the reference points as normal.
iii) Place the control in reference mode

iv) Readjust the axis reference switch to operate at between -1.0 mm and -1.5 mm as read on the position readout display.
v) Reset the machine software limits as per Section 8.5.3.

8.5.3
Z axis software limits

After changing a feed motor, an encoder, a feed drive belt or an axis limit switch, it is necessary to reset the software limits.

i) Temporarily override the software limits.
   Change machine parameter 48 to +1000
   Change machine parameter 49 to -1000

CAUTION:
The Z axis software limits are now inactive. Use the handwheel only. Approach the bump stops at a creep feed rate.

ii) Place the control in reference mode

iii) Slowly handwind the axis and record the position display figure as the top position switch just operates.
iv) Deduct 0.4 mm from the reading to obtain the positive software limit figure.
v) Deduct 150.1 mm from the positive software limit figure to obtain the negative software limit figure.
vi) Enter these values as follows:
   Machine parameter 48 - positive software limit (Z axis)
   Machine parameter 49 - negative software limit (Z axis)
vii) Using the joystick check that the quill can be run into the positive software limit at rapid and the negative software limit at maximum feed rate, and off again without tripping the extreme limits.
viii) Exit from the control reference

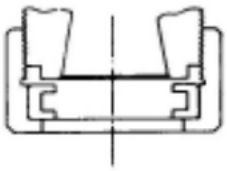
ix) Check that at least 150 mm of stroke can be achieved.
x) Record the new software limits on the Machine Software Parameter Record which may be found in the door pocket of the electrical cabinet.

8.SERIES II INTERACT 4-HEAD MAINTENANCE

8.6 QUICK CHANGE LOCKNUT ASSEMBLY

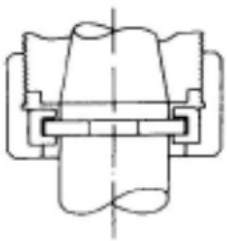
i) Remove three screws from locknut.

ii) Screw on nut assembly as far as possible - then back off 1 turn.

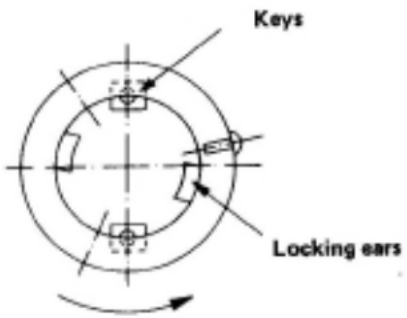


iii) Insert standard Quick Change Adaptor and tighten locknut until tight.

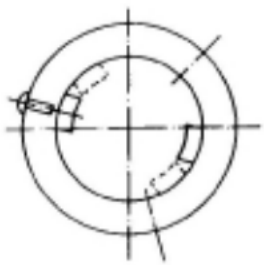
iv) Screw in longest button head screw (dog pt.) in hole that permits greatest amount of rotation for unlocking. (This is usually the hole closest to the ear).



v) Rotate nut back to load position. This is when locking ears and keys are in line.



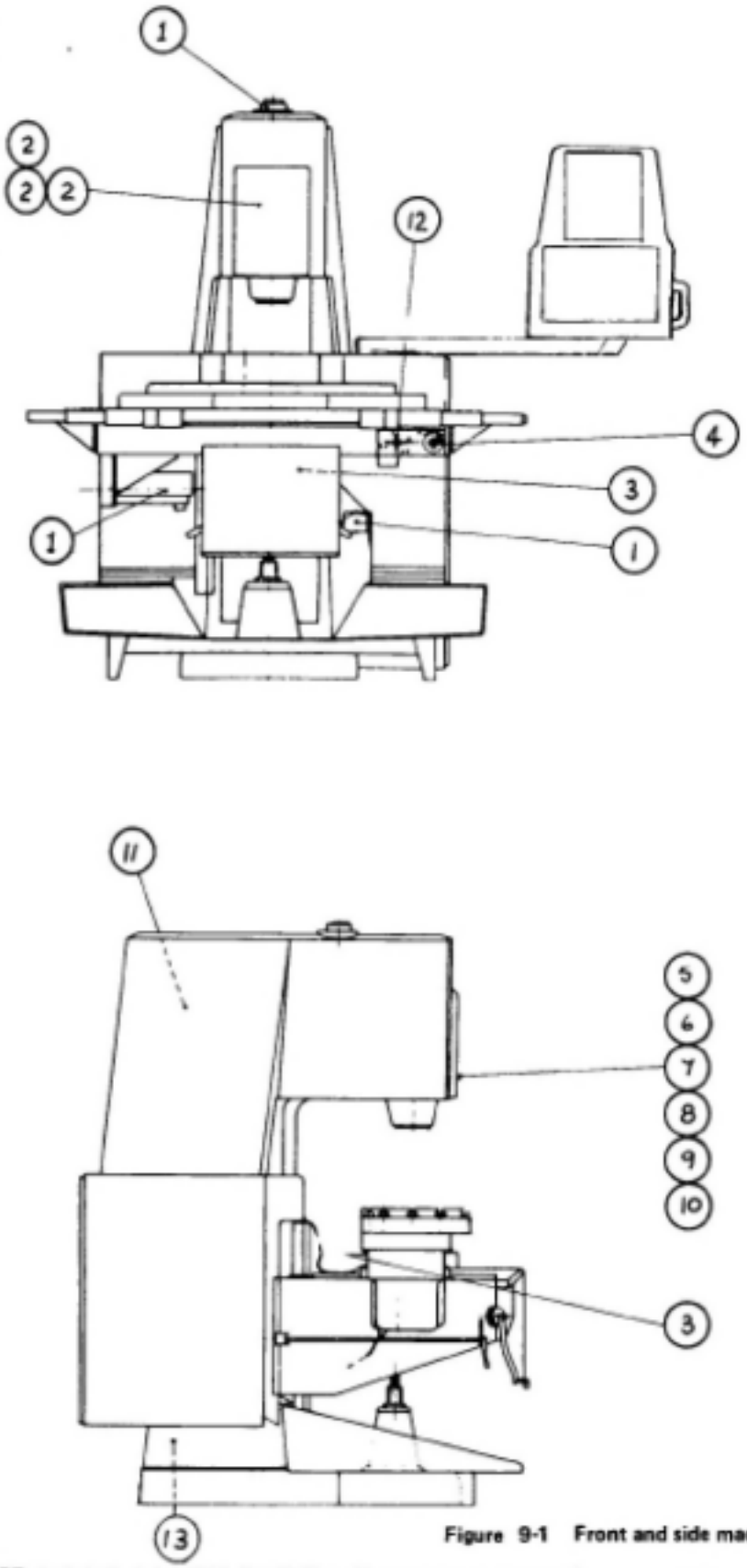
vi) Insert cadmium plated screw in hole that is in line with locking ear. This is identifying screw so operator knows how to load adaptors.



vii) Put remaining screw in only open hole. Spindle is now ready to use.

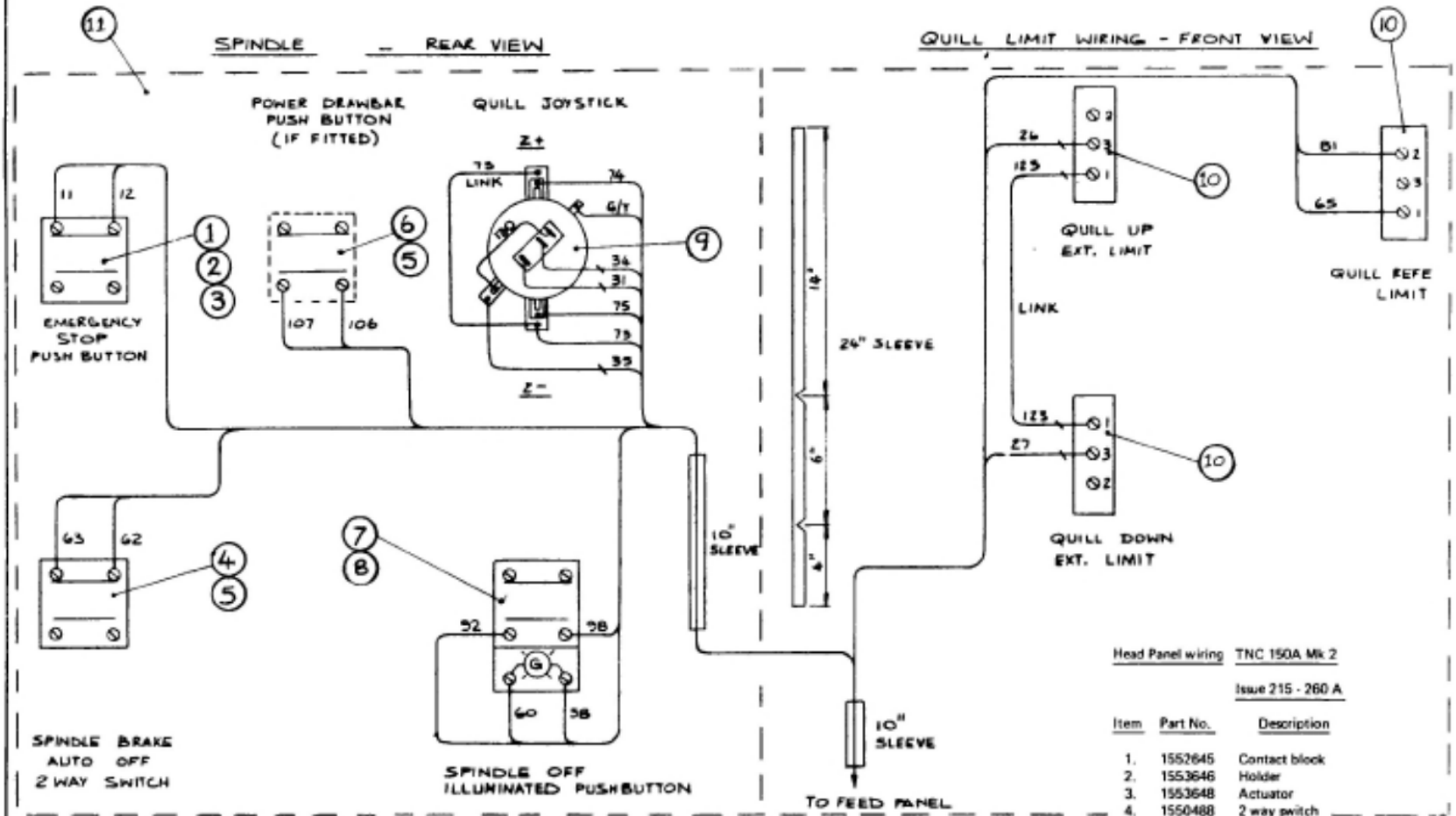
9. SPARE PARTS

9.1 ELECTRICAL PARTS LIST/DIAGRAMS AND DRAWINGS



Item	Part No.	Description
1	1551208	Axis Drive Motor SEM MT3024-64 encoder
2	1553471	Z Limit Switch CT7MR3 - A2
3	1553672	X and Y axis limit switch
4	1553359	Handwheel encoder
5	1550442	Illuminated (green) pushbutton
6	1550440	Replacement bulb
7	1550493	Contact block K
8	1550549	Emergency Stop Button SMBR - P - 01
9	1550488	Brake switch
10	1553589	Joystick 2-way Z axis
11	1551235	D.C. Spindle Motor SICME 2M112L
12	1553590	Joystick X and Y axis
13	1552697	Coolant pump

Figure 9-1 Front and side machine elevation.



SPINDLE PANEL LOOM

NO	CABLE TYPE	TOTAL LENGTH
9	+ RED 1mm²	14 FT
17	− BLUE 1mm²	14 FT
1	G/Y 1mm²	14 FT

BLACK PVC SLEEVE

LENGTH	TYPE	DIA
10"	1585238	13 MM
10"	1585238	13MM
24"	1585232	10 MM

3/4" ANACONDA QUILL TO PANEL LENGTH 7 FT

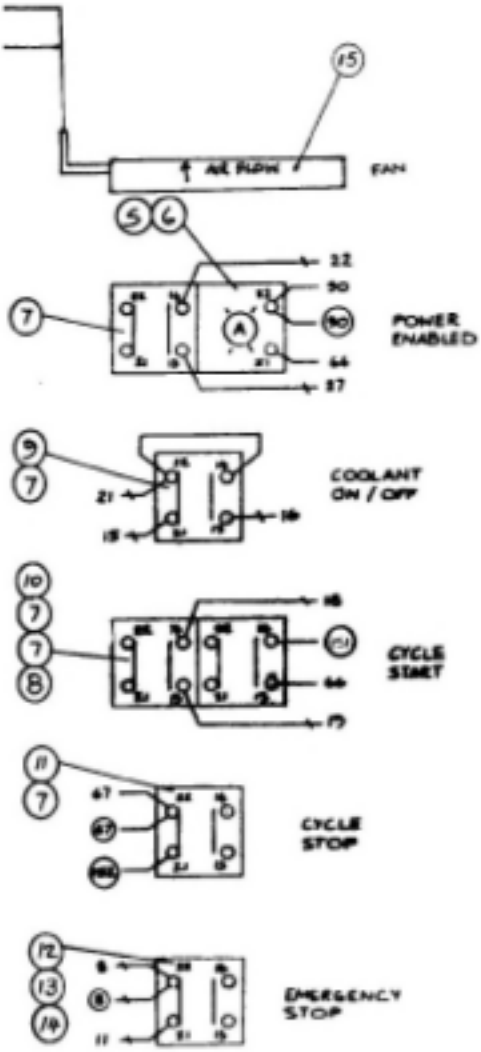
Head Panel wiring TNC 150A Mk 2

Issue 215 - 260 A

Item	Part No.	Description
1.	1552645	Contact block
2.	1553646	Holder
3.	1553648	Actuator
4.	1550488	2 way switch
5.	1550493	Contactor block
6.	1550478	Button
7.	1550442	Illuminated button
8.	1550440	Replacement bulb for item 7
9.	1553589	Z Joystick
10.	1553471	Switch
11.	2159541	Switch plate

(Interact 4/151B or 155B)

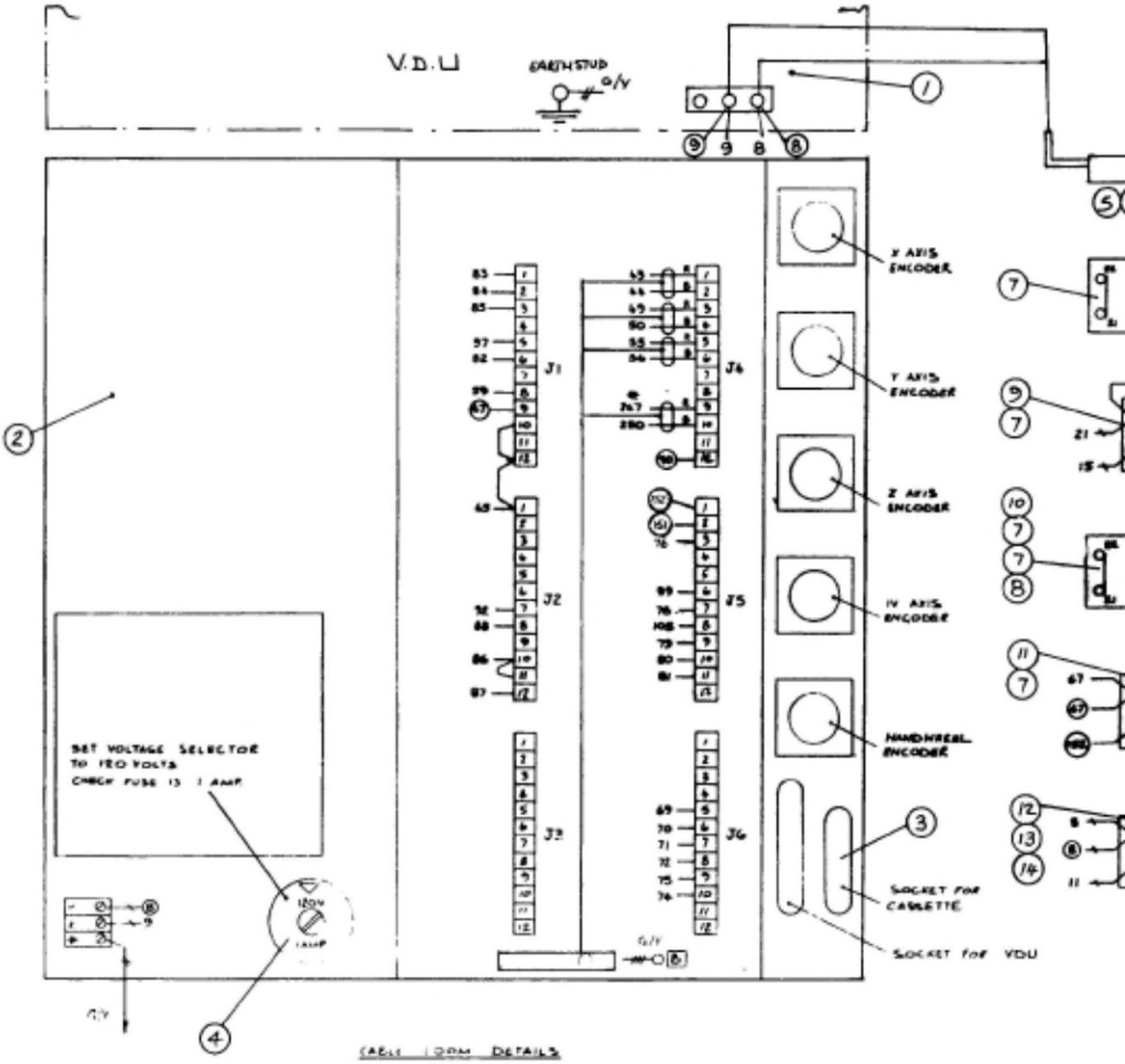
Figure 9-2 Head panel wiring issue 215-260A TNC 151B/155B



Item	Part No.	Description
1	1553383	Heidenhain VDU 12" BE 211
2	1553305	Heidenhain TNC 151/B
3	1525335	Heidenhain cable (cassette)
4	1551379	Fuse 1 amp L2080A
5	1550439	Illuminated pushbutton (amber)
6	1550440	Replacement bulb
7	1550493	Contact block K
8	1550496	Assembly screw BT 430
9	1550495	Coolant switch (3 way)
10	1550494	Pushbutton black
11	1550487	Pushbutton red
12	1552645	Emergency stop
13	1553646	Emergency stop
14	1553648	Emergency stop
15	1553015	Fan
		TNC 155/B OPTION IF FITTED
1	1553399	Heidenhain VDU 12" BE 411
2	1553307	TNC 155/B

VDU

Figure 9-3 Pendant wiring -- rear view 215 – 259 Issue D.



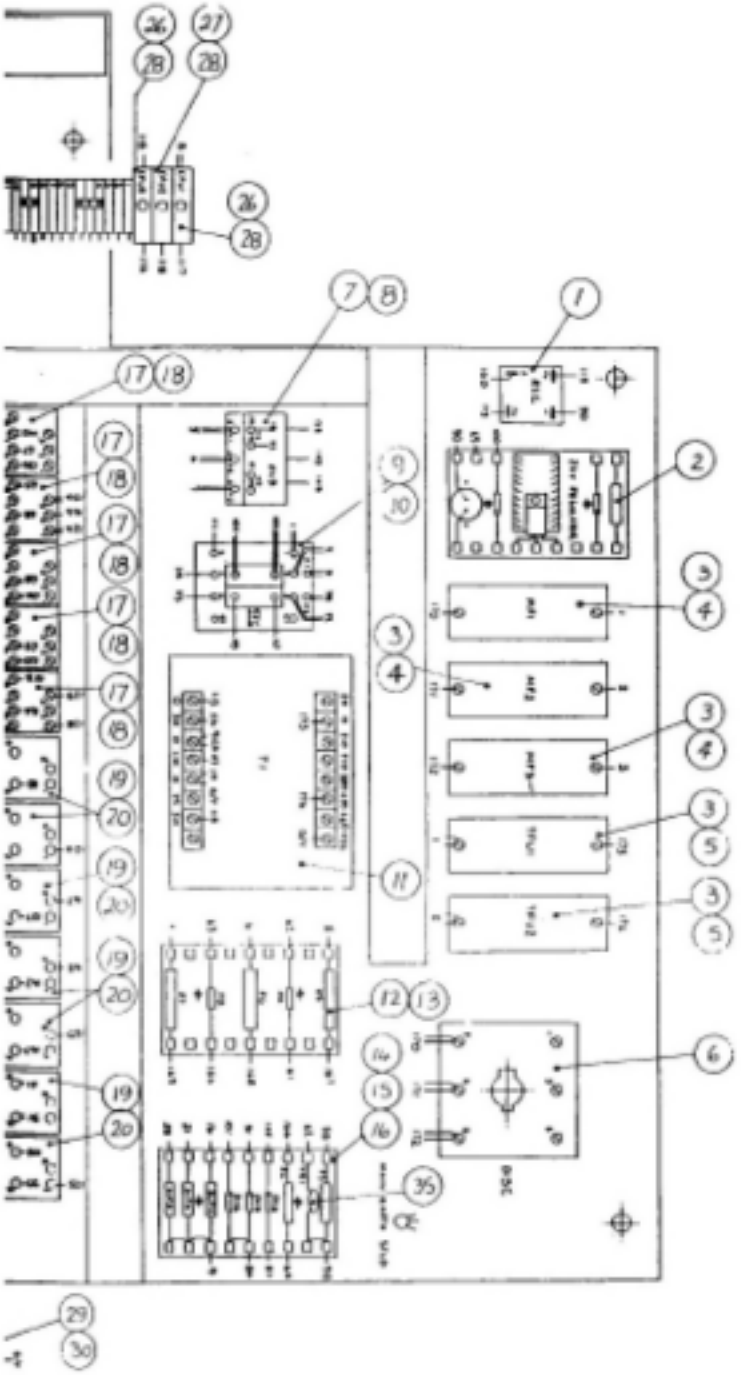
CABLE LOOM DETAILS

NO	CABLE TYPE	LENGTH
24	RED 1mm²	120"
24	BLUE 1mm²	120"
1	G/Y 1mm²	120"
2	SCREENED	120"
1	SCREENED &	FIG*
1	G/Y 2.5mm²	120"

F.G. SLEEVE 32mm DIA LENGTH = 56"

○ - INTERNAL PENDANT LINK

Figure 9-3 Pendant



1	1554300	Rectifier
2	4648712	24V Regulator Board
3	1551343	Fuseholder RS20H
4	1551338	20 amp fuse
5	1551348	10 amp fuse
6	1551829	Isolator P3/63/V/SV6
7	1554628	Overload Z006
8	1554632	Overload Base KZ00
9	1551078	Contactor K2 - 09A - 01 (5FC)
10	1551084	Contactor aux HN 10 (2 off)
11	1553957	Transformer T1
12	1555390	Resistor 3R3 12W (R5, R6, R7)
13	1555005	Diode IN4002 (D4, D5)
14	1555309	Resistor 100R 1W (R3, R4)
15	1555005	Diode IN4002 (D14, D15, D16)
16	1555054	Suppressor (SUP, 3, 4, 5)
17	1552921	Relay MY4 110V AC
18	1552927	Relay Base PYF 14N
19	1552922	Relay LY2 24 VDC
20	1552928	Relay Base PTF 08N
21	1553883	Choke (L1, L2, L3)
22	1555751	Capacitor 0.1 Microfarad Bosch
23	1551423	Axis Drive Unit Z15 - 1A - 240V
24	1551424	Mounting Plate
25	1553903	Autotransformer T2
26	1551394	Fuse 5 amp
27	1551392	Fuse 2 amp
28	1553870	Fuse Block SAK1
29	1553140	Socket Lid
30	1553139	Socket
31	1553894	Earth Bar
32	1553892	Mounting Pillar (2 off)
33	1553899	Earth Terminal 4 mm sq (3 off)
34	1553779	Earth Terminal 6 mm sq (1 off)
35	1555080	Varistor (VR1)

Figure 9-4 Feed cabinet wiring diagram.

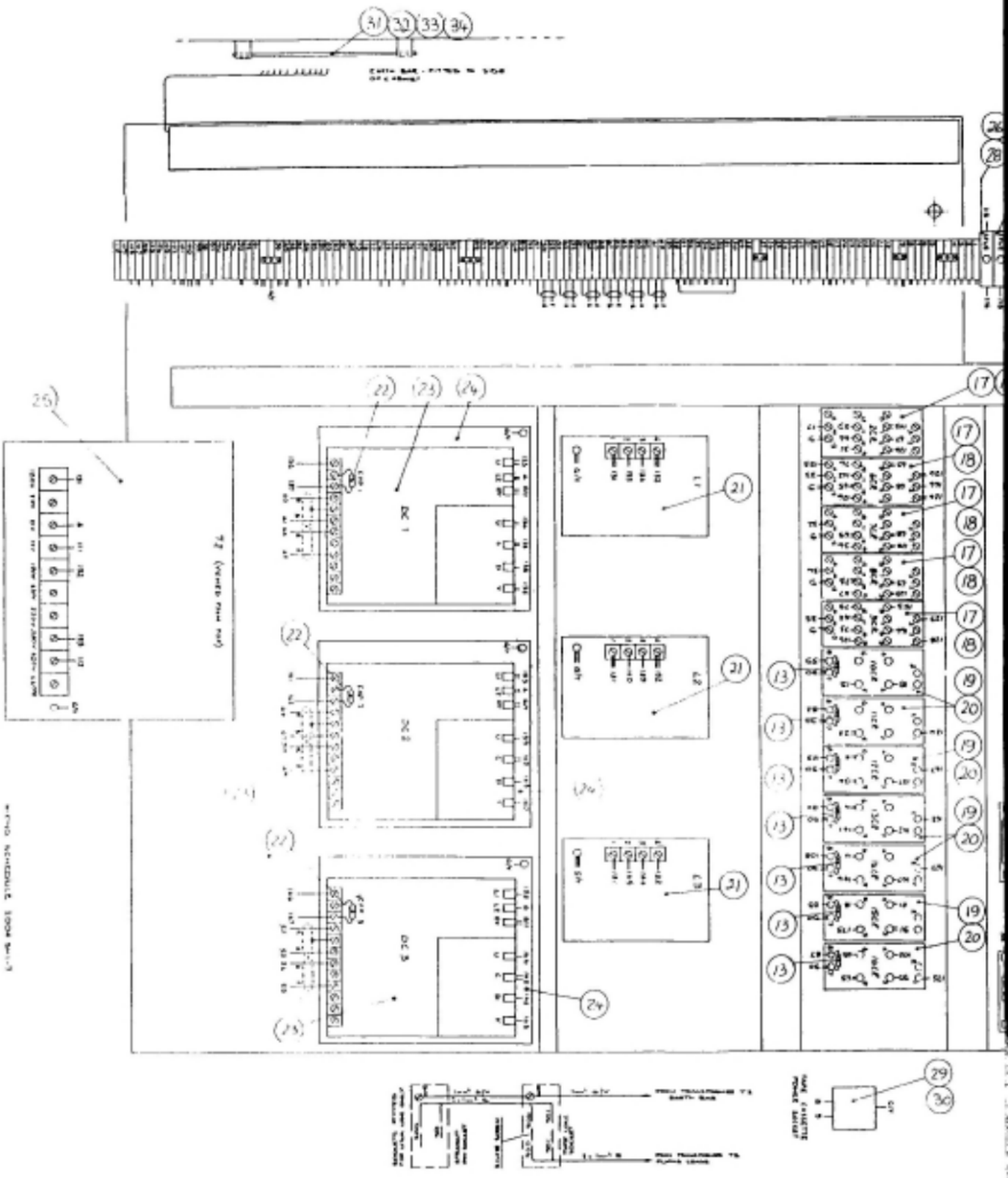
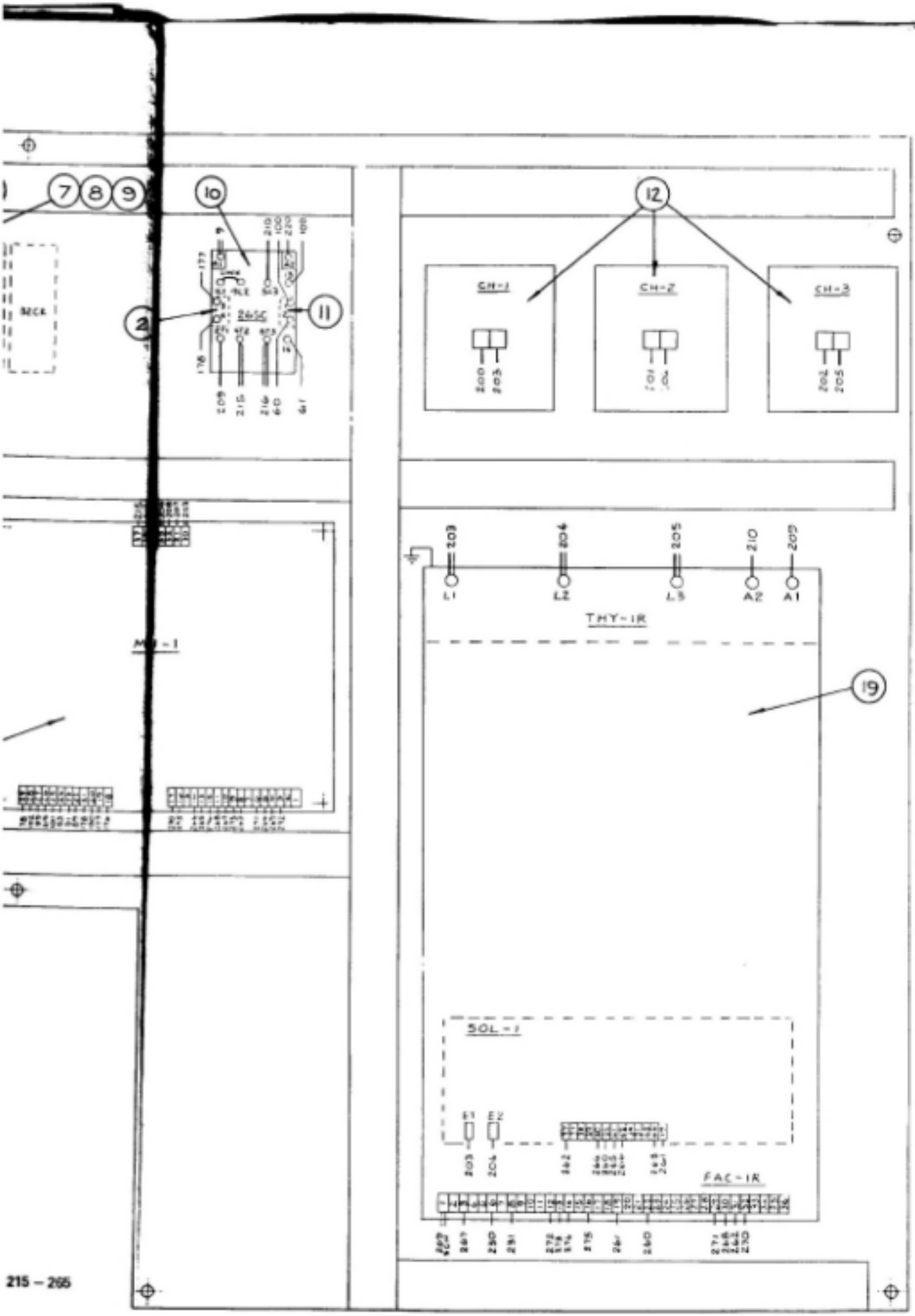
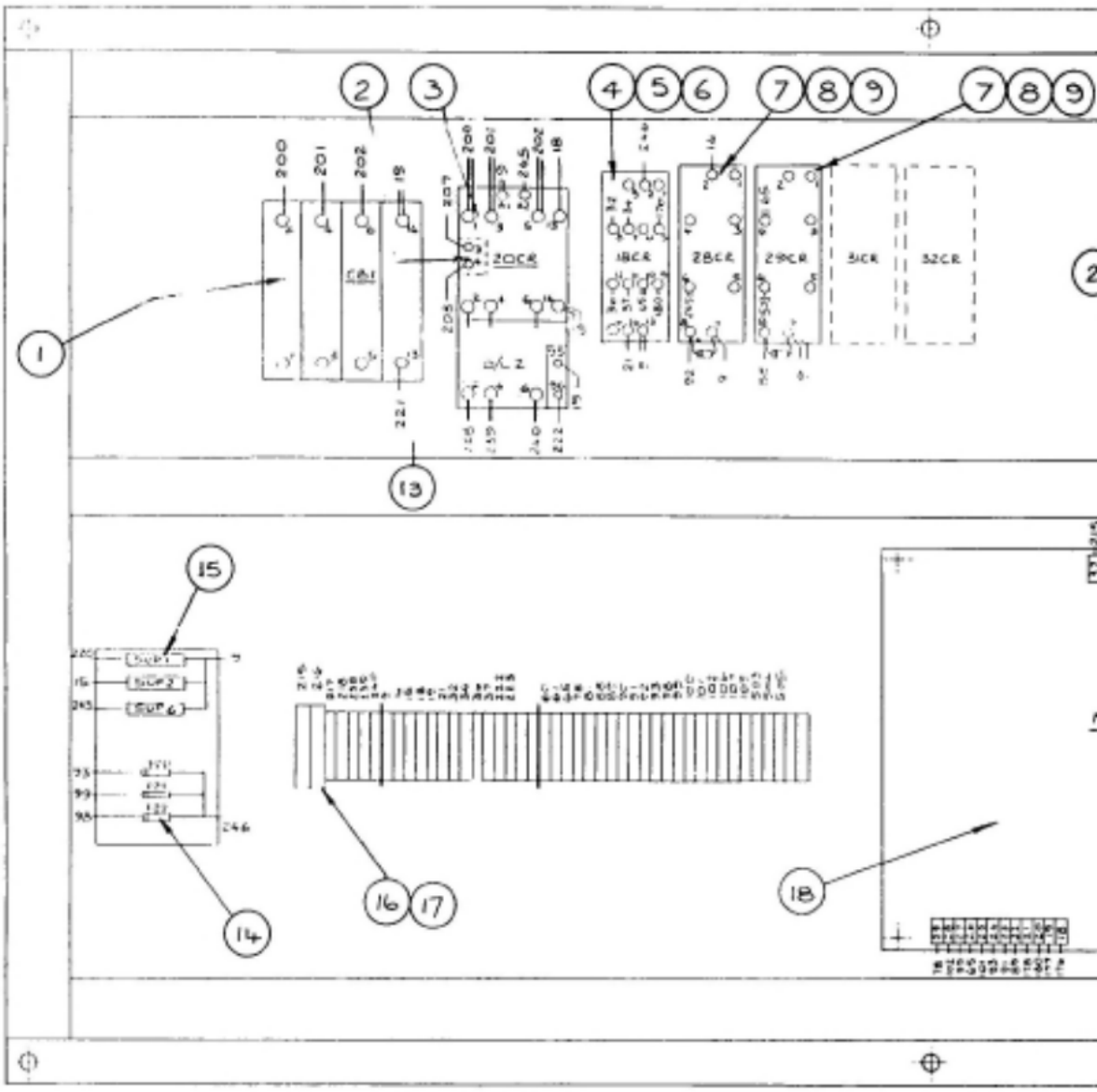


Figure 9-4 Fe


7
8
9
10
11
12
2
CH-1
CH-2
CH-3
L1
L2
L3
A2
A1
THY-1R
19
SOL-1
FAC-1R



Item	Part No.	Description
1.	1554895	3 OFF 32 Amp Circuit Breaker
2.	1551084	Aux Contact N/O
3.	1551082	Spindle Fan Contactor
4.	1552921	Relay Spindle Command
5.	1552927	Relay Base
6.	1552933	Relay Clips
7.	1552922	Relay
8.	1552928	Relay Base
9.	1552933	Relay Clips
10.	1551081	Spindle Motor Contactor
11.	1551083	Aux Contact N/C
12.	1551236	Choke (Line Reactor)
13.	1552554	Fan Overload 0.6/0.9 Amp
14.	1555005	Diode IN4002
15.	1555105	Suppressor
16.	1553886	Terminal Sak 4
17.	1550174	Terminal Sak 2.5N
18.	1551471	Interface Board
19.	1551470	Spindle Drive Unit

Figure 9-5 Spindle cabinet electrical wiring layout (KTK Spindle drive) 215 — 265

10.PREVENTIVE MAINTENANCE

10.1 PREVENTIVE MAINTENANCE

10.1.1
Warranty
As quoted in Bridgeport's terms and conditions:
"Bridgeport warrants to the original purchaser only that all products manufactured by it will be free from defects in materials or workmanship for a period of twelve (12) months from date of shipment to such purchaser, **such warranty to remain in effect if and only if such products are used in accordance with all instructions as to maintenance and operations set forth in manuals and instruction sheets furnished by Bridgeport**".

10.1.2
Single shift operation using coolant on all operations

MAINTENANCE LEVEL 1

10.1.2.1
Daily maintenance
i) Check automatic lubricating system oil level and fill as necessary.

CAUTION:
Use only Mobil Vactra No. 2 or equivalent to ensure maximum effectiveness of the lubricating system.

ii) Clean dirt and chips from ways. **Do not use an air hose.**

10.1.2.2
Weekly maintenance
In addition to daily maintenance:
i) Clean chips and dirt from the entire machine and wipe down.
ii) Check that oil is reaching all slideways.
iii) Clean and apply light coat of oil to steel chip guards on knee and to the guards between the table and saddle.
iv) Remove rear cover and inspect the spindle motor fan filter. If necessary wash out in water and detergent.

MAINTENANCE LEVEL 2

10.1.2.3
6 Monthly maintenance
In addition to weekly maintenance:
i) Remove automatic lubricator filter and clean.
ii) Check spindle drive belt tension. The force required to produce a deflection of 11.5 mm at the mid-scan of the belt should be between 90 N and 120 N. If necessary adjust the belt tension by releasing the motor bracket, supporting the motor weight on the rollers and using the jack screw to vary the motor to spindle centre distance.
iii) Run the spindle at 1800 r.p.m. and check for spindle spline rattle. If excessive rattle is present, re-set the spindle damper as follows:
a) Remove the top cover (2159953).
b) Slacken 3 screws retaining dampers assembly.
c) Insert Ø 3/16" rod into tommy bar hole and apply a torque of about 50 lb/in in an anti-clockwise direction (front right going).
d) Whilst maintaining this torque re-tighten the 3 retaining screws.
e) Replace top cover.
iv) Check feed drive belt tensions on all axes as per Sections 7.1.1, 7.1.2 and 8.3.
v) Check the slideway gib settings and adjust if necessary as per Section 7.8.
vii) Check lost motion as per Section 7.9.
vii) Check axis drive motor brushes for wear. The minimum recommended length of carbon, before brush replacement is 6 mm (0.24").
viii) Check spindle motor armature brushes for wear. The minimum recommended length of carbon before brush replacement is 19mm. Remove any dust with CLEAN DRY COMPRESSED AIR.

10.1.3
Multiple shift operations and punitive environments

10.1.3.1
Definitions
Bridgeport is defining 3 shift operations, 5 or more days per week, as a multiple shift operation.
Punitive environments are considered to be those in which the workpiece is cut dry or when cutting Magnesium or Carbon.
If the workpiece is cut dry (Cast Iron, Carbon or Magnesium) extra-ordinary precautions should be taken by the customer. The following recommendations are made as a guide:
i) Specially designed vacuum systems at the cutting tool are recommended.
ii) Air hoses must not be used to clean the machine, use industrial vacuum cleaners.

MAINTENANCE LEVEL 1

10.1.3.2
Daily maintenance
i) Check automatic lubricating system oil level and fill as necessary.

CAUTION:
Use only Mobil Vactra No. 2 or equivalent to ensure maximum effectiveness of the lubrication system.

ii) Clean dirt and chips from way surfaces and apron. Use industrial vacuum cleaner.
iii) Clean and apply a light coat of oil to way surfaces.

10.1.3.3
48 hour maintenance
In addition to daily maintenance:
i) Clean the entire machine using an industrial vacuum cleaner.
ii) Check that oil is reaching all slideways.
iii) Clean and apply light coat of oil to steel chip guards on knee and to guards between the table and saddle.

MAINTENANCE LEVEL 2

10.1.3.4
Weekly (144 hour) maintenance
In addition to 48 hour maintenance:
i) Remove rear cover and inspect the spindle motor fan filter. If necessary wash out in water and detergent.

10.1.3.5
3 monthly maintenance
In addition to weekly maintenance:
i) Remove automatic lubricator filter and clean.
ii) Check spindle drive belt tension. The force required to produce a deflection of 11.5 mm at the mid-span of the belt should be between 90 N and 120 N. If necessary adjust the belt tension by releasing the motor bracket supporting the motor weight on the rollers and using the jack screw to vary the motor to spindle centre distance.
iii) Run the spindle at 1800 r.p.m. and check for spindle spline rattle. If excessive rattle is present, re-set the spindle damper as follows:
a) Remove the top cover (2159953).
b) Slacken 3 screws retaining dampers assembly.
c) Insert Ø 3/16" rod into tommy bar hole and apply a torque of about 50 lb/in in an anti-clockwise direction (front right going).
d) Whilst maintaining this torque re-tighten the 3 retaining screws.
e) Replace top cover.
iv) Check feed drive belt tensions on all axes as per Sections 7.1.1, 7.1.2 and 8.3.

v) Check the slideway gib settings and adjust if necessary as per Section 7.8.
vi) Check lost motion as per Section 7.9.
vii) Check axis drive motor brushes for wear. The minimum recommended length of carbon, before brush replacement is 6 mm (0.24").
viii) Check spindle motor armature brushes for wear. The minimum recommended length of carbon before brush replacement is 19mm. Remove any dust with CLEAN DRY COMPRESSED AIR.

10.4 MAINTENANCE SUMMARY

Machine Duty & Environment		Single Shift, Coolant			Multiple Shift & Punitive				
Maintenance Interval	Daily	Weekly	3 Mthly	Yearly	Daily	48 Hr.	144 Hr.	3 Mthly	6 Mthly
Check auto lubricator level	X	X		X	X	X	X		X
Clean dirt and chips from ways	X	X		X	X	X	X		X
Clean and apply oil to ways					X	X	X		X
Clean entire machine		X		X		X	X		X
Check that oil is reaching slideways		X		X		X	X		X
Check and apply oil to sliding guards		X		X		X	X		X
Clean spindle motor fan cover				X			X		X
Clean spindle drive belt housing				X			X		X
Clean quill housing				X			X		X
Clean auto lubricator filter				X					X
Check spindle speed				X					X
Check feed drive belt tension				X					X
Check slideway gib settings				X					X
Check feed drive motor brushes			X					X	

11. FAULT FINDING

This section is a brief guide to enable simple electrical faults to be readily identified and to localise any problem area due to the more obscure faults that cannot be dealt with individually in this chapter.
The procedure has been written in a logical sequence which must be followed from the beginning. The results of this procedure will also be most useful in any further dialogue should the fault not be localised.

WARNING:
Parts of this procedure involve working with **ELECTRICALLY LIVE CIRCUITS** and must only be performed by personnel qualified to do so.

11. FAULT FINDING

Switch on machine isolator

Is the SPINDLE OFF lamp illuminated?

NO → Check fuses MF1, MF2, MF3, TFU1, TFU2 & CFU3

YES ↓

Are the control displays illuminated?

NO → Check fuse CFU1 and fuse at back of control. Also check 110 v A.C. supply to control between wire 8 and 9

YES ↓

Is the VDU display ON?

NO → Adjust brightness and contrast on display. Check lead between control & VDU connected. If display still not working - then faulty VDU

YES ↓

Does the control display read POWER INTERRUPTED?

YES → Press CE on control

NO ↓

Does the control display read RELAY EXT D.C. VOLTAGE MISSING?

YES → Verify operation of 24 v D.C. regulator board by checking 24 v (± 2 v) between terminals 90 and 65

NO ↓

Does control display:
CONTROL ELECTRONICS DEFECTIVE
EMERGENCY CUT OUT DEFECTIVE
PROGRAMME MEMORY DEFECTIVE

YES → Switch off at isolator and restart, if fault clears then carry on otherwise faulty control unit

END OF CHECKS

1. FAULT FINDING (cont.)

Does power enabled button illuminate on being pressed?

YES → Turn to next page

NO ↓

Does display read: POWER INTERRUPTED?

YES → Press [CE] button on control

NO ↓

Check 110 v AC between earth and the following terminal block nos:

11 — NO → Emergency stop button latched on pendant

YES ↓

12 — NO → Emergency stop button latched on spindle control panel

YES ↓

22 — NO → Feed overload OL/3 tripped (manual reset)

YES ↓

Hold POWER ENABLED button IN and check 110 v AC between earth and the following terminal block nos:

27 — NO → Faulty Power Enabled switch

YES ↓

28 — NO → Thermal overload inside X axis motor (auto reset)

YES ↓

29 — NO → Thermal overload inside Y axis motor (auto reset)

YES ↓

30 — NO → Thermal overload inside Z axis motor (auto reset)

YES ↓

Does contactor 5FC pull in?

NO → Faulty contactor

YES ↓

Faulty power enabled bulb

END OF CHECKS

11. FAULT FINDING (cont.)

Does POWER ENABLE button extinguish on being released?

NO → See below

YES

One of the three axes is on an AXIS LIMIT SWITCH. With POWER ENABLE button pressed, drive off axis limit by using electronic handwheel or joysticks or reference

END OF CHECKS

Does the control display read
REF: PASS OVER REFERENCE POINTS
when [CE] pushbutton is pressed?

YES

NO

Does control display read:
MACHINE PARAMETER 0?

YES

Input machine parameter into control unit. Machine parameter for machine is inside electrical panel

END OF CHECKS

11. FAULT FINDING (cont.)

Does the machine pass over its reference points when the PROGRAMME START pushbutton is operated?

YES → Turn to the next page

NO

Is there 110 v A.C. between earth and main terminal block number 17?

NO → Check lubrication oil level

YES

Are the two small green LED's marked BTB illuminated at the top right hand corner of the feed drive cards?

NO → Check the two small 160 mA fuses mounted in clips at the bottom right hand corner of the feed drive cards

YES

Does the (Z) / (Y) axis / (X) (14) / relay (13) / (12) CR pull IN?

NO → Faulty relay

YES

Does the (Z) / (Y) axis drive green / (X) LED's marked FG illuminate?

NO → Faulty drive

YES

Faulty drive
Faulty drive motor
Faulty control

END OF CHECKS

Do the joystick axis controls operate correctly?

YES → See below

NO

Does the control display read:
DEFECT ON (Z) (Y) (X) MEASURING SYSTEM

YES → Faulty encoder or associated cable on the indicated (Z) (Y) (X) axis

NO

Does the control display read:
CONTROL – ELECTRONICS DEFECTIVE or PROGRAMME MEMORY DEFECTIVE?

YES → Faulty control unit

NO

Does the control display read:
GROSS POSITIONING ERROR?

YES → Axis slide tight - check that axis is free by winding axes via belts. Feed drive card incorrectly adjusted or faulty

NO

Do the joysticks controls operate correctly in the rapid mode?

YES → Neutral microswitch on rear of joystick incorrectly adjusted or faulty

NO

Joystick rapid pushbutton faulty
Joystick directional microswitches faulty

END OF CHECKS

11. FAULT FINDING (cont.)

Does the machine run and position correctly in programme?

YES → Turn to next page

NO ↓

Does the control display read: CONTROL – ELECTRONICS DEFECTIVE or PROGRAMME MEMORY DEFECTIVE?

YES → Faulty control unit

NO ↓

Does machine attempt to move to programmed position?

NO → Does control display read: LIMIT SWITCH?

YES → Programming error

NO ↓

Feedrate override control at zero. Miscellaneous function in programme block not completed e.g. M03 - M04 - spindle start - M51 - indexer (if fitted) Feed hold by spindle drive interlock circuit. Check relays 22, 23 and 24 are pulled in.

YES ↓

Do the position readout display figures correspond to the programmed axis positions to within ± 0.01 mm (0.0004")?

NO → Tool length or diameter compensation in operation. Feed drive card incorrectly adjusted or faulty

YES ↓

If the position readout figures correspond to the programmed axis positions, but the machine is not positioning as indicated, check the tightness of the belt pulley on the axis motor shaft and the tightness of the rotary encoder coupling on the other end of the axis motor

END OF CHECKS

11. FAULT FINDING (cont.)

Will the spindle start on M03 (M04) programme command?

YES → Turn to page **11-10**

NO

Does the spindle fan start or pressing cycle start?

NO → Has relay 20CR pulled in? NO → Check spindle fan overload O/L 2.
Check spindle thermal overload between terminals 222 and 223.
Check cycle start button.
Check drawbar interlock is closed
Check drawbar interlock is closed
(IF FITTED – see drawing 215 – 211)

YES → Has relay 20CR pulled in? YES → Check circuit breaker CB1 has tripped
Faulty spindle drive unit

YES

Has contactor 26SC pulled in?

NO → Faulty contactor 26SC
Faulty contacts of 20CR

YES

Does the drive ready relay RL2 (AND LED3) on the FAC–IR card drop out on starting?

YES → Check the machine phase rotation is correct
Check LED 1 is illuminated (FAC–IR Card)
Check monitor position 7 is zero prior to spindle start.
Check for short circuit on spindle motor armature.
Faulty spindle drive unit (short circuit thyristor)

NO

Check monitor voltages on the FAC–IR card agree with table 2 (section 6)

NO → Faulty spindle drive unit (short circuit thyristor)

YES

Has relay 15CR pulled in on spindle command M03 (M04)?

NO → Is 24 volts present on terminal 86 during M03 (M04) command? NO → Check 24 volt output from TNC terminal J2/10.
Faulty TNC controller.

YES → Is 24 volts present on terminal 89 during M03 (M04) command? NO → Faulty diode D15
drive healthy relay RL3 dropped out on MTI card.
Drive relay RL2 dropped out on FAC–IR card. (AND LED3 out) on FAC–IR card
Faulty spindle drive unit.

YES

Faulty relay 15CR

Has relay 18CR pulled in?

NO → Faulty relay 18CR

YES

11. FAULT FINDING (cont.)

Has relay RL2 pulled in on MTI board?

NO → Faulty MTI board
Faulty 18 CR relay contacts

YES ↓

With a spindle speed commanded
Does monitor position 4 voltage correspond to TNC command voltage?
(10 volts equals 4,000 r.p.m.)

NO → Check TNC output spindle command voltage between J4/9 and J4/10 (10 volts DC corresponds to 4,000 r.p.m.)

YES ↓

Does monitor position 5 correspond to position 4?

NO → Faulty Ramp Circuit

YES ↓

Faulty Spindle Drive Unit

Is LED 9 energised?

NO → Check logic operation table 3 section 6

YES ↓

Is LED 1 energised?

NO → Faulty Preconditioning Circuit

YES ↓

Has tacho loss indicator energised (see figure 6-3)?

YES → Faulty tacho

NO ↓

Check motor field output voltage between terminals 217 and 218.
Check for open circuit of motor armature, between terminals 215 and 216

11. FAULT FINDING

Does the programme continue to run after a spindle start?

NO

If no speed achieved, signal is sent from the MTI board to the TNC verification input (24 volts on terminal 78) a programme stop secures after 3 seconds
On spindle start, check on the MTI board:
Relay RL5 drops out (zero speed)
Relay RL4 pulls in (at speed)
Check circuit closes between terminals 29 (wire 78) and 25 (wire 101) of the MTI board.

YES

Faulty spindle drive unit

Does the spindle reach the correct speed and hold this speed under load?

NO

Check firing pulse indicators LED 201 – 6 or LED 207 – 12 are all energised
Check monitor position 8 under load. Reading of 3 volts corresponds to full load.
Check test points as in table 2.
Incorrect setting of current limit controls RV11, RV12

YES

Does the spindle stop following an M05 command?

NO

Check relay 16CR pulls in on M05 command.

YES

Does the tool change lamp come on after M25 command?

Check 24 volt ouput on terminal 87 on M05 command.

NO

Check 24 volt output on terminal 92 and relay 28CR pulls ir after Z axis move to tool change zero position.

END OF CHECKS

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