2.6 Power Drawbar - Actuation and Tool Release

(Refer to Figure 2-6)

If the quill is fully retracted and the spindle in its oriented position, then the Power Drawbar can be actuated. There are three steps in this sequence:

1. The locking collar (ground plane) is placed around a recess at the top of the spindle and a switch detects this condition. Quill must be UP.

2. Air pressure is applied to a large area diaphragm which floats on springs relative to the machine frame. As soon as all lost motion is taken up, the internal force generated by the diaphragm deflects a hollow push rod to compress a stack of Bellville washers.

3. When the primary diaphragm has travelled full stroke, a secondary small area diaphragm strokes the inner rod of the dual drawbar downward to spread the collet surrounding the projection on the tool holder and rap the tool holder a light blow to release the tool holder from the spindle taper. Full stroke on the latter operation permits the tool change arm to proceed with its withdrawl cycle of the holder from the spindle.

For tool retention, the sequence of events takes place in the reverse of the Tool Release order. The open collet is closed by venting the secondary air chamber, and it is kept closed by further stroke of the inner drawbar which brings a locking ring around this collet. The collet has internal claws which are placed under a recess in the tool holder projection so that when the air in the primary chanber is released, the full spring force of 2100 lbs. is applied to these claws which keep the tool holder drawn up into the #35 taper of the spindle.

2.7 Tool Changer Arm

An air hydraulic cylinder drives a crank whose connecting rod is a rack. This rack rotates a pinion driving a large sprocket wheel engaging a chain. Attached to the chain and properly guided is the tool change arm. Extension and retraction of the piston rod will advance and withdraw the hand on its guiding member. A cam track provides the means to step the tool holder down in the tool change sequence to lower, then raise, the holder up into the spindle for engagment with the power drawbar.

The tool changer hand has two fingers which reach half way

around the tool holder. At the tip of each finger is a claw which is cam operated to release the tool at the retracted end of the hand's stroke and at the extended end of the stroke just before the power drawbar actuates. The mechanical advantage of the spring loaded linkage gives a firm grip to tools weighing up to 10 lbs. in their transit from carrousel to spindle and vice versa. Refer to Figure 2-7.

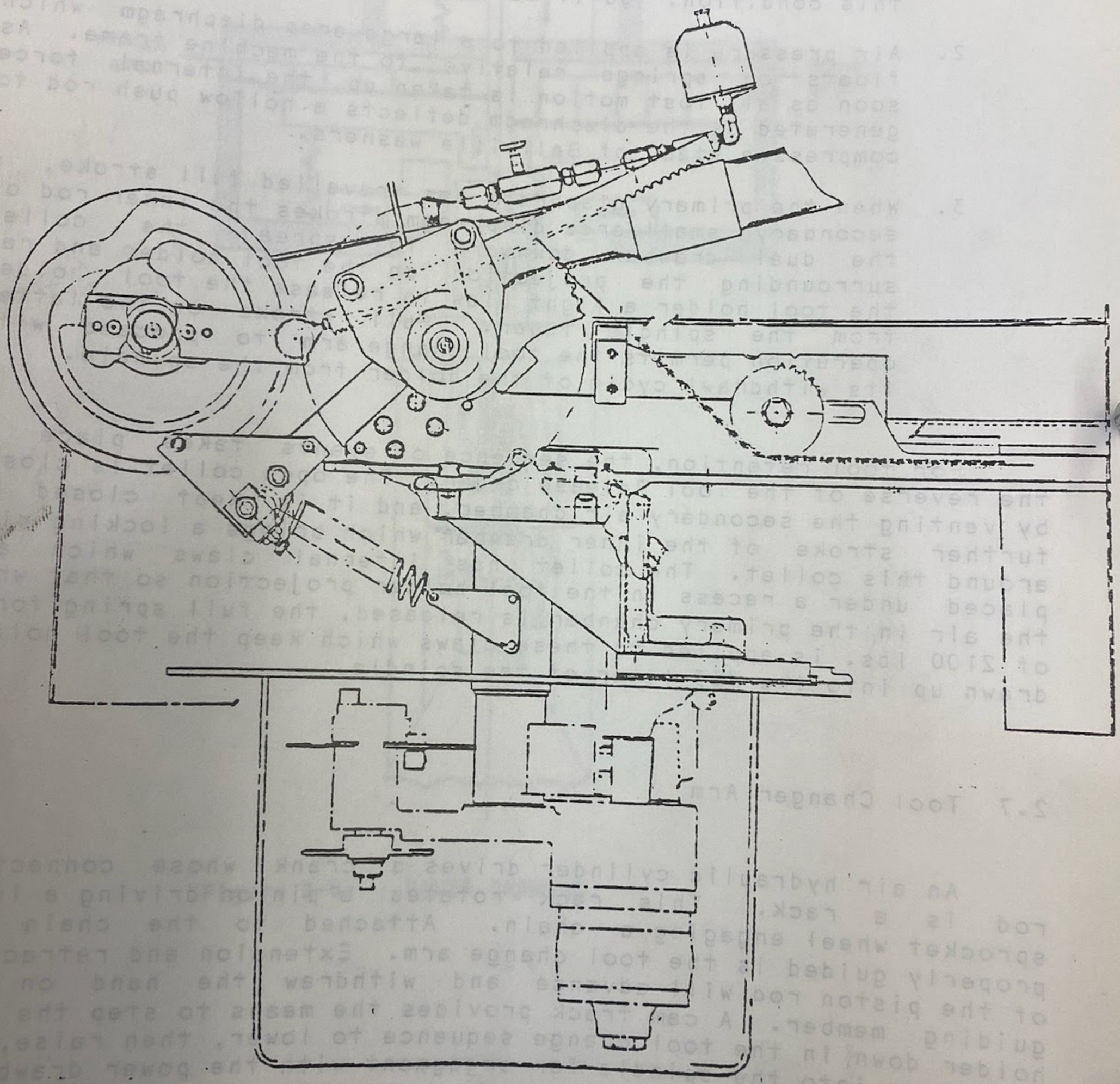
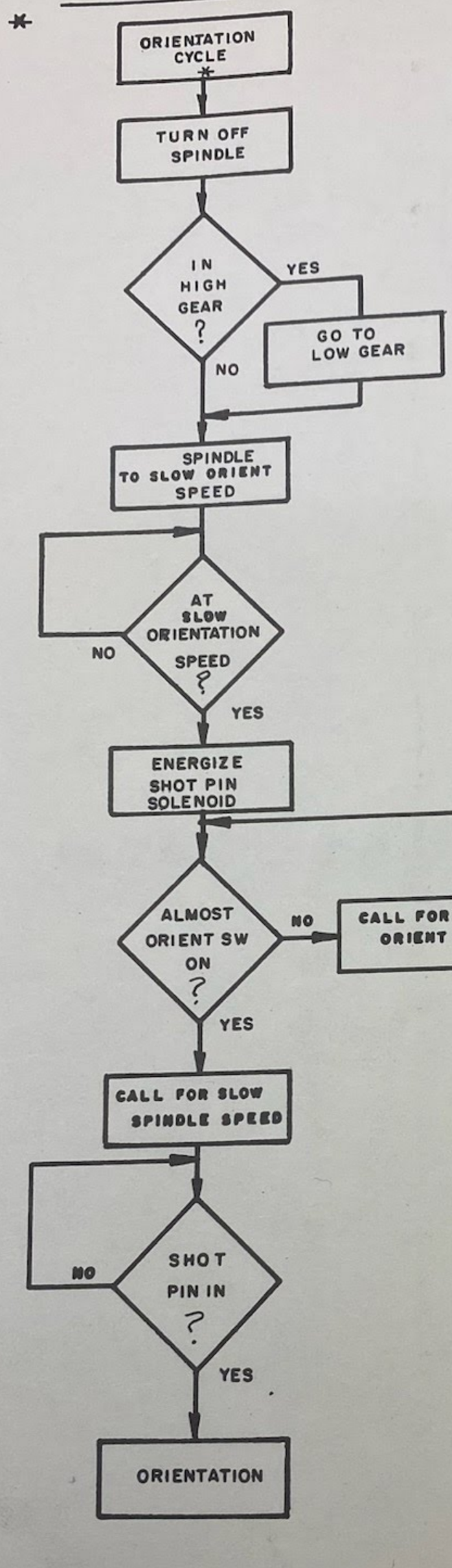
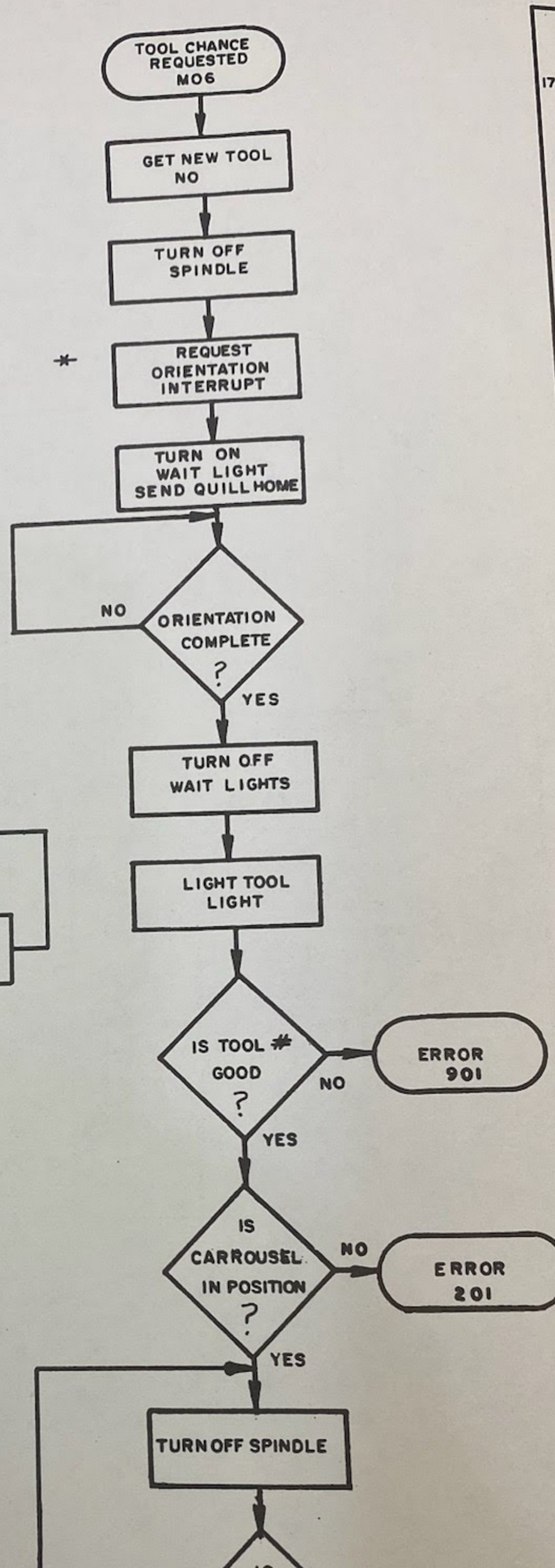
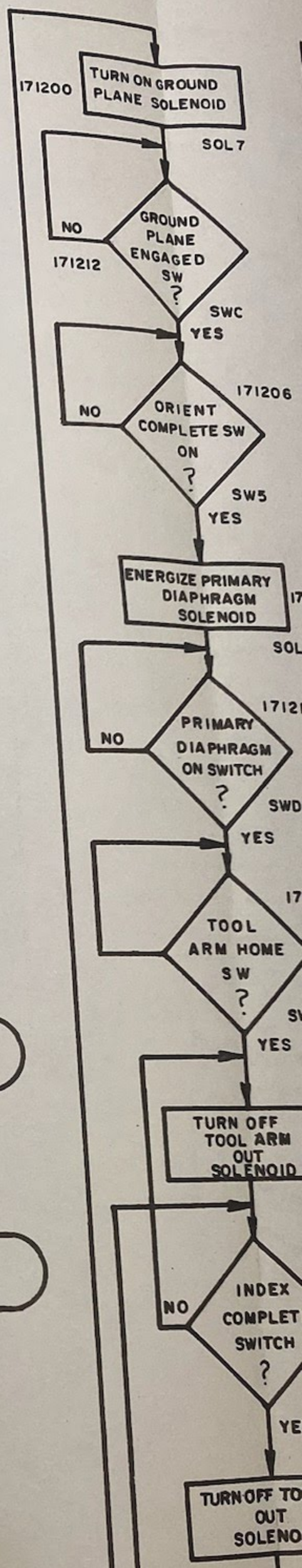


Figure 2-7: Tool Changer Arm

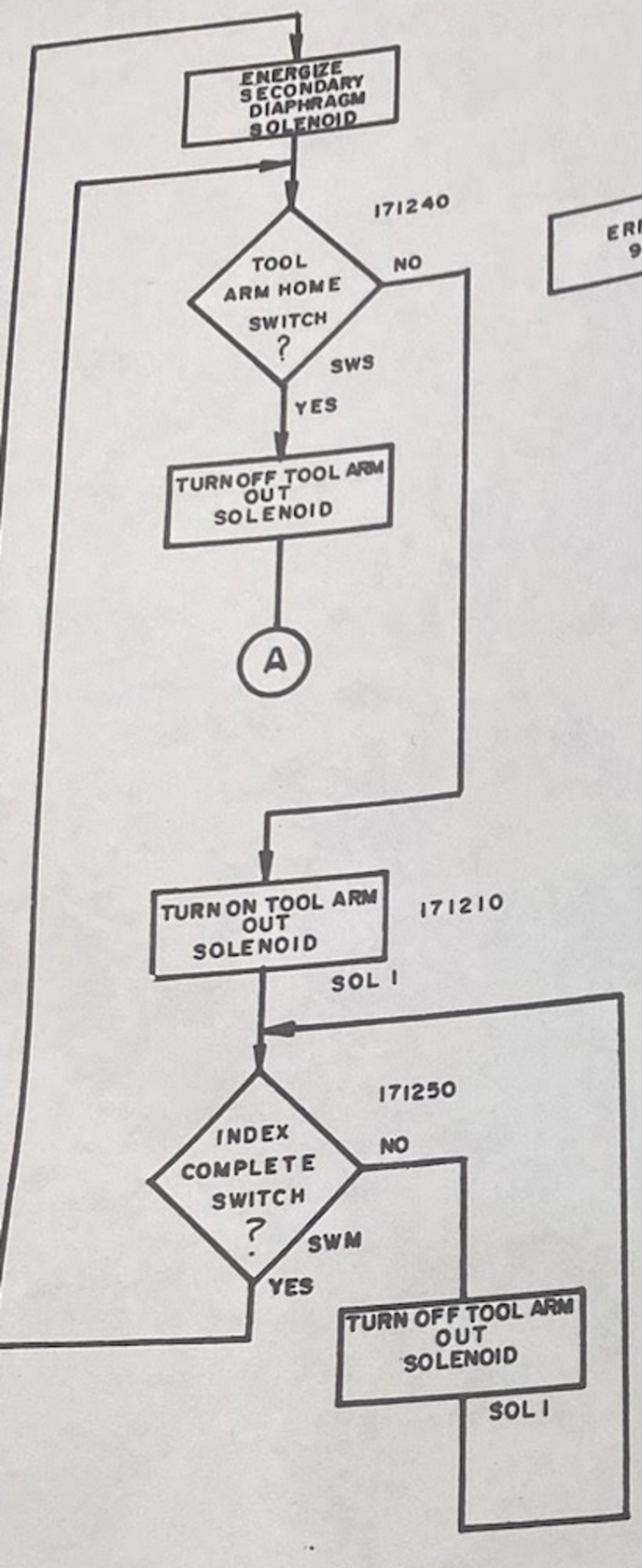
TO REMOVE TOOL:

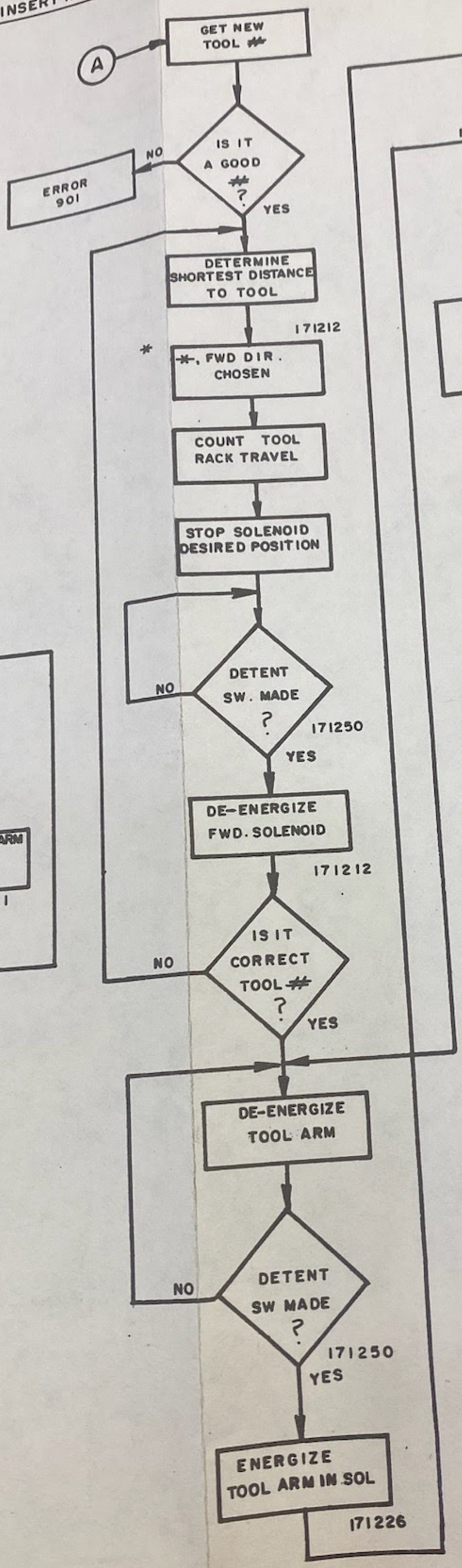






TO INSERT NEW TOOL:





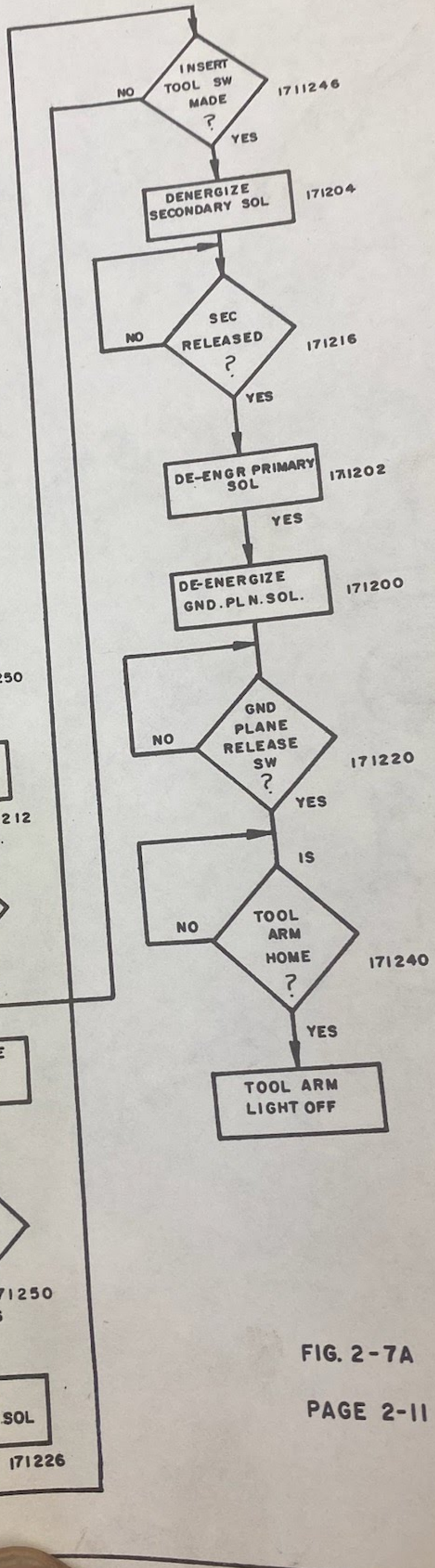
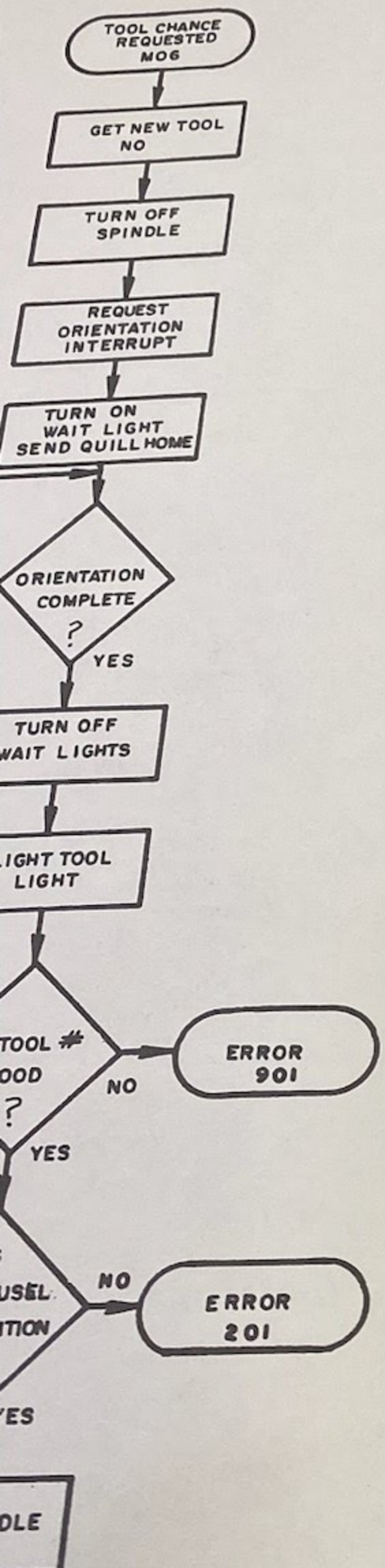
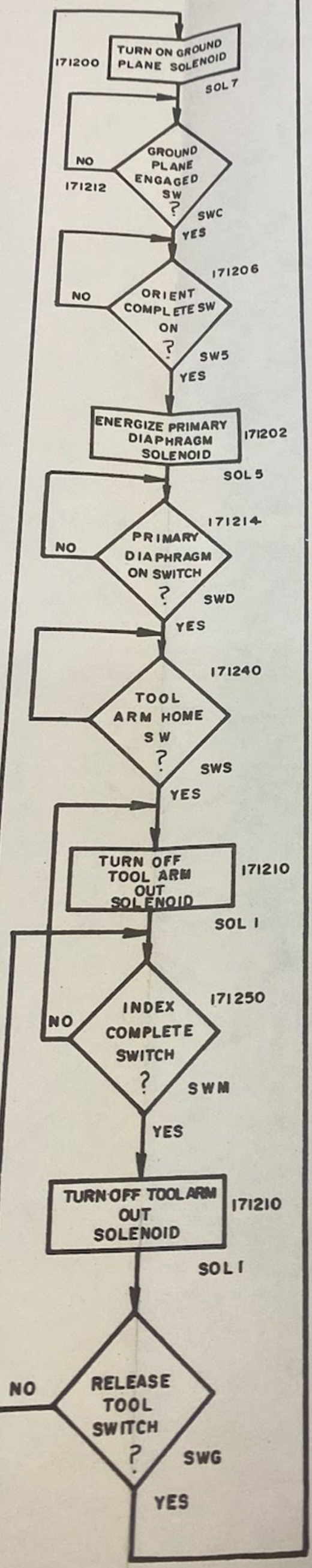
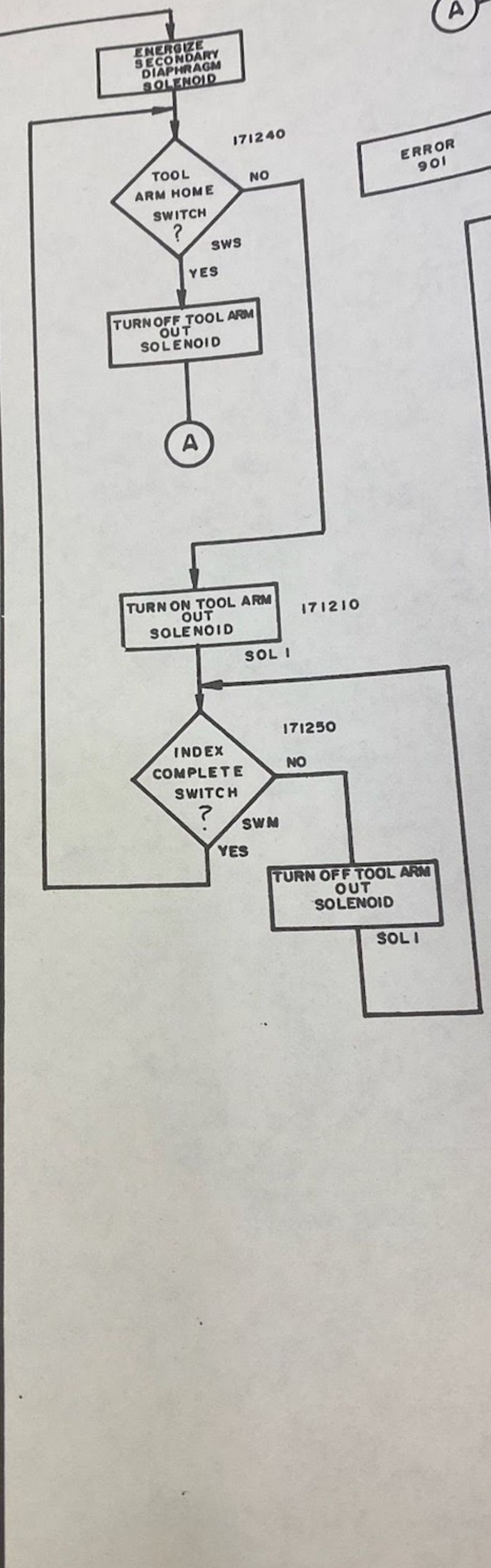


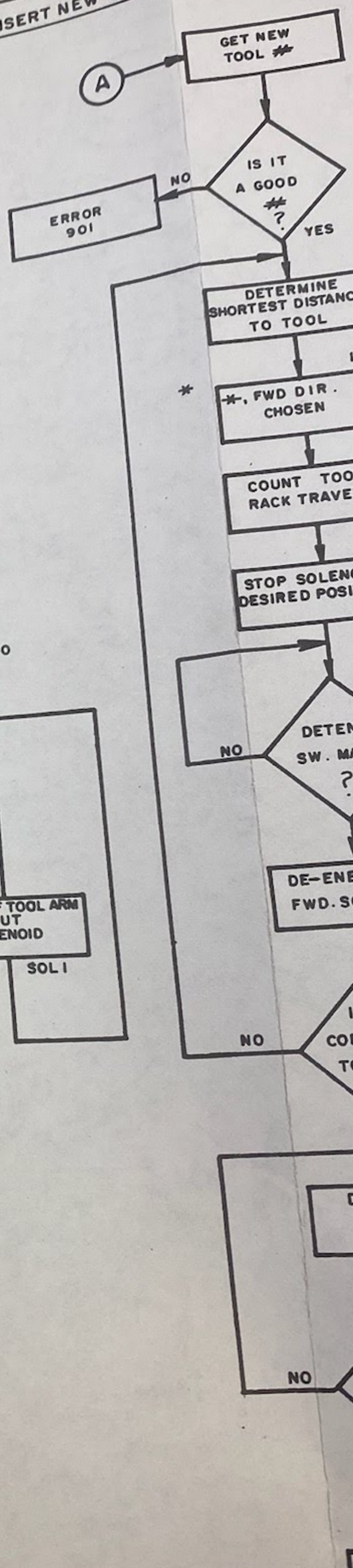
FIG. 2-7A

TO INSERT NEW TOOL:









2.7.2 Hydraulic Fluids

There is a single fluid bowl located above the tandem cylinder for arm motion. The following hydraulic fluids are approved for use in the Series I BTC:

Mobil Velocite 6
Shell Tellus 10 or 15
Exxon Spinestic 10 or 34
Gulf - Gulfspin 35
Arco Diamond or Dura S-60
Texaco Spindura 10

2.8 Knee Drive

filter/lubricator. To set the air flow, turn the knob clockwise to OFF then back clockwise to ON approximately 1/2 turn (3/4 turn is full flow).

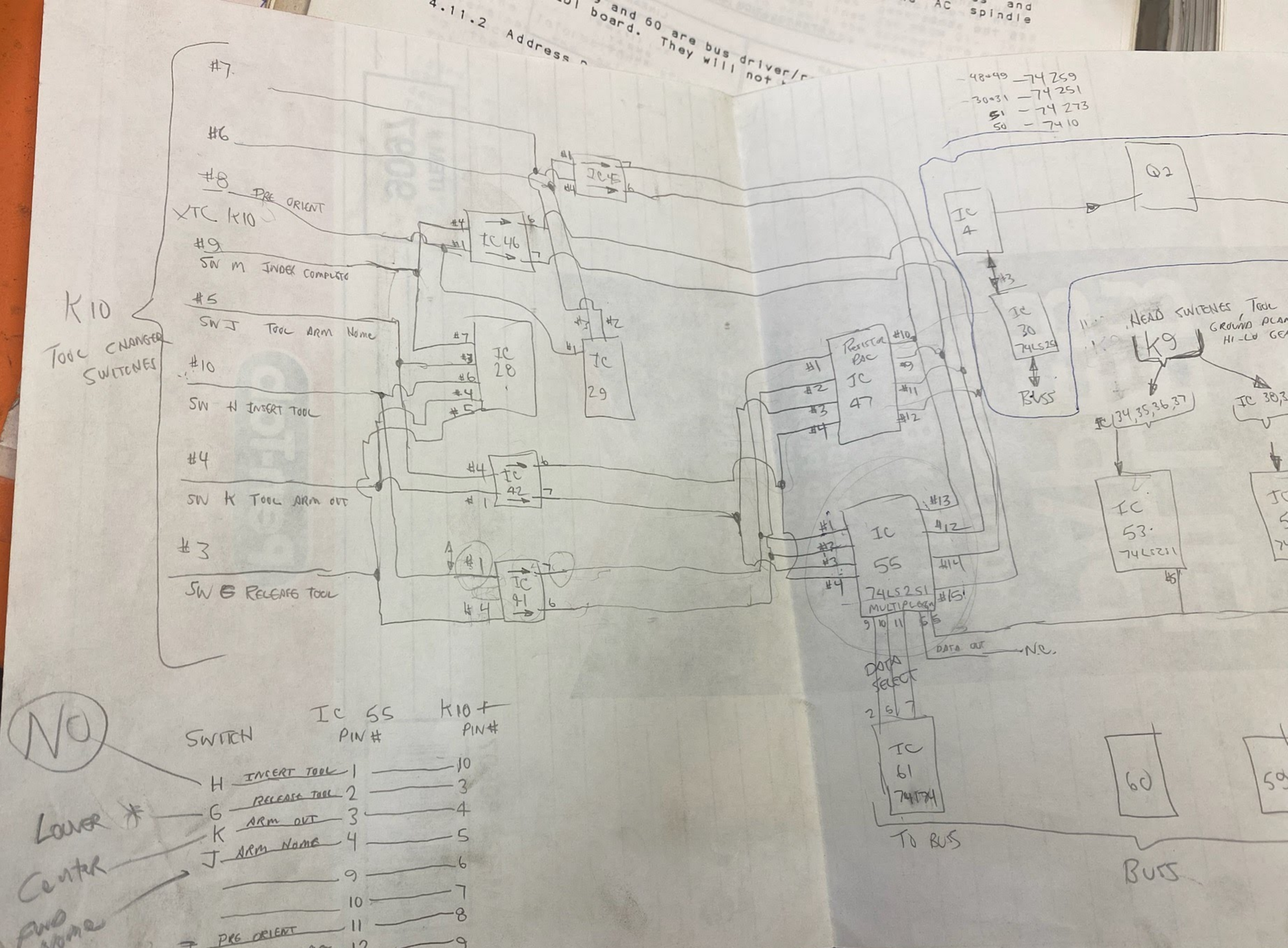
WARNING

Do not operate system with the air system lubricator valve OFF.

If the system air pressure gets too low a pressure operated spring compensated spool will shut off the chip blower to save air. If the pressure drops below approx. 55 PSIG, the entire system will shut down to prevent possible damage to the fingers or the spindle shaft. The red LIMIT light will come on.

2.10.2 Air System Lubricants

The air system should be lubricated with Texaco Capella 22 oil. See data on lube bowl.



4.11.2 Address
and 60 are bus driver/r
board. They will not
AC spindle
K10
TOOL CHANGER SWITCHES
#7
#6
#8 PRE ORIENT
XTC K10
#9 SW M INDEX COMPLETE
#5 SW J TOOL ARM HOME
#10 SW H INSERT TOOL
#4 SW K TOOL ARM OUT
#3 SW G RELEASE TOOL
IC 45
IC 46
IC 28
IC 29
IC 42
IC 41
RESISTOR PAC IC 47
IC 55 74LS251 MULTIPLEXER
IC 4
IC 30 74LS251
BUSS
Q2
48+49 — 74259
30+31 — 74251
51 — 74273
50 — 7410
HEAD SWITCHES, TOOL
K9
IC 34,35,36,37
IC 53 74LS251
DATA OUT
N.C.
DATA SELECT
IC 61 74174
TO BUSS
60
BUSS
NO
SWITCH
IC 55 PIN #
K10 + PIN #
H INSERT TOOL 1 — 10
G RELEASE TOOL 2 — 3
K ARM OUT 3 — 4
J ARM HOME 4 — 5
9 — 6
10 — 7
I PRE ORIENT 11 — 8
M INDEX COMPLETE 12 — 9
LOWER *
Center
FWD HOME

A36 MILD

XTC K11 PIN — AIR SOLENOID DRIVERS

6 PRIM DISPERSION + AIR BLAST

7 SECONDARY DIAPHRAM

XTC K10 PIN

* 9 SW M INDEX COMPLETE

* 5 SW J TOOL ARM HOME

10 N INSERT TOOL

4 K TOOL ARM OUT

3 G RELEASE TOOL

SPE BOARD SEC POWER CABLE?

YES Pg 4-59

K9 HEAD SW INPUT

K10 CAROUSEL SW INPUT

K11 SELENOID CONTROL CABLE

K12 SPINDLE DRIVE CABLE

4.11 XTC BOARD FIGURE 1930760, SHEET 2

The (XTC) Solenoid and Tool Changer system switch interface board is the primary interface between the switches and solenoids. It also contains the interface to the AC spindle drive.

4.11.1 Driver/Receivers

IC57, 58, 59 and 60 are bus driver/receivers similar to the ones on the ZD1 board. They will not be explained again here.

4.11.2 Address Decoding Circuits

All addresses on the XTC board are in the 1712XX range. Address decoder IC62 continuously monitors bits BRD7 through BRD12H and BBS7. When address 1712XX appears pin 9 of the decoder goes high. During any bus transaction BSYNC is asserted. This raises pin 7 of the decoder high, latching it in its state at that moment. BSYNC also strobes IC61 which latches the six address bits BRD1 through BRD6 as AL1 through AL6.

The XTC contains registers which accept data from the bus and others that place data on the bus. IC33 decodes the address bits to enable the proper registers.

Switch information from the head and carrousel tool station encoder are received through K9 on the XTC board.

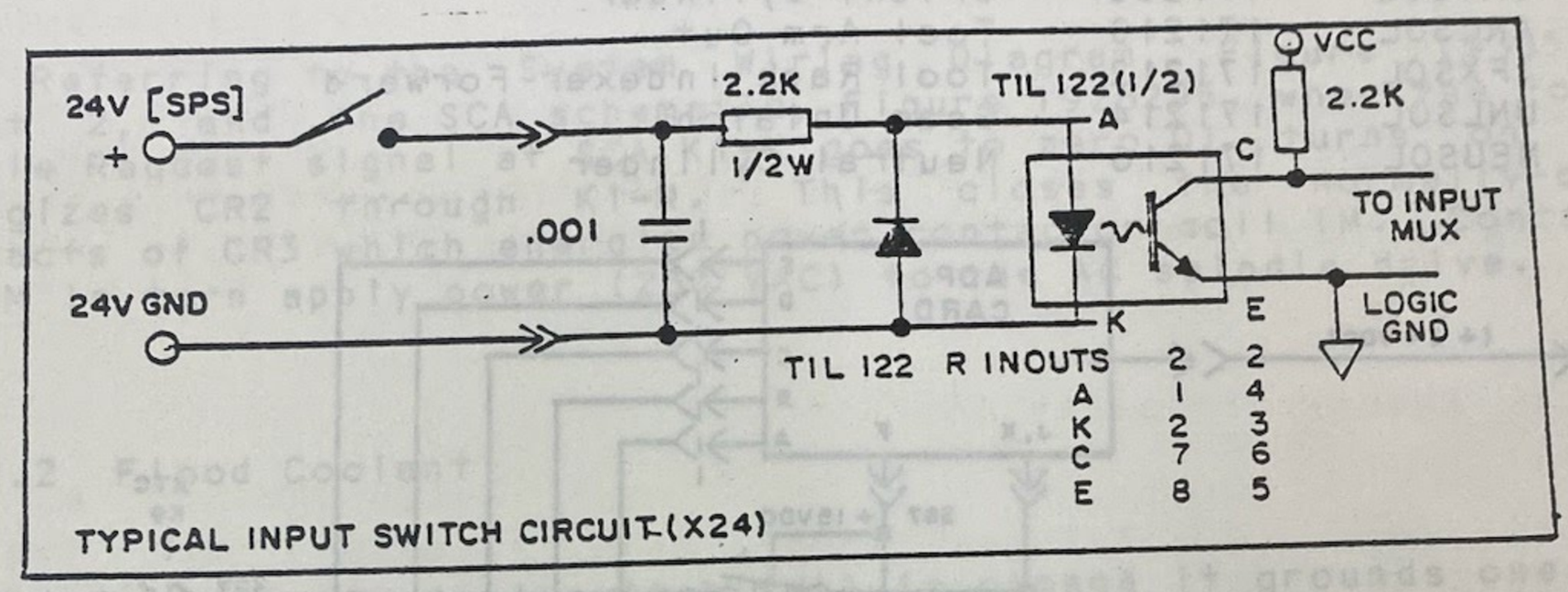
171200	K9-5	Gear Latched SWR	
171202	K9-4	Hi Gear SWP	
171204	K9-3	Lo Gear SWQ	
171206	K9-13	Orientation Cycle Complete SWS	
171210	K9-14	Orientation Machine Reset SWU	
171212	K9-15	Ground Plane Engaged SWC	
171214	K9-16	Primary Stroke Complete SWD	
171216	K9-17	Start of Sec. Stroke SWE	
171220	K9-18	Ground Plane Released SWF	
171222	K9-19	Tool Pos SWA	
171224	K9-10	Tool Pos SWB	
171226	K9-9	Tool Pos SWC	Carrousel encoder
171230	K9-8	Tool Pos SWD	
171232	K9-7	Tool Pos SWE	
171252	K10-8	Pre-Orient SWT	

The information from the remaining carrousel switches is received

through K10 addresses.

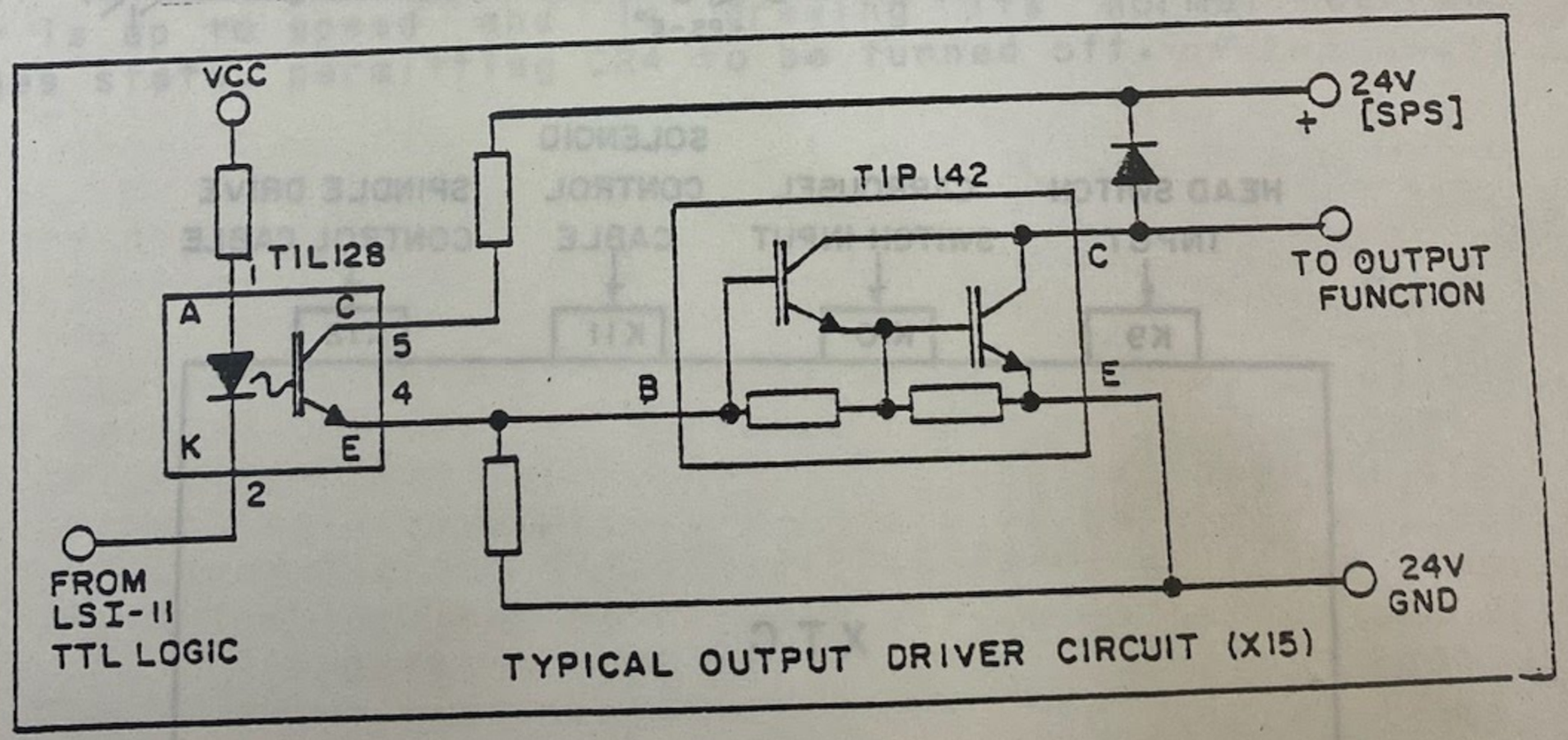
171240	K10-5	Tool Arm Home SWJ
171242	K10-4	Tool Arm Out SWK
171244	K10-3	Release Tool SWG
171246	K10-10	Insert Tool SWH
171250	K10-9	Carrousel Index Step Complete SWM

See typical switch input circuit below.



TYPICAL INPUT SWITCH CIRCUIT (X24)

The registers which accept data from the bus are called write only registers. Write only registers IC48 and IC49 provide data to the output drivers circuits which enable the solenoids. The outputs to the solenoids are through K11. See typical output driver circuit below.



TYPICAL OUTPUT DRIVER CIRCUIT (X15)

The output on K11-M goes to the SPE board (Solenoid Power Enable), see Figure 1930760, which sends 24 VDC to the pneumatic solenoids. When address 171260 is decoded data, through IC51, goes to the speed control DAC IC18, and operational amplifier

4.13.5 Dynamic Braking

The dynamic braking functions consist of a small printed circuit card mounted to the base panel on the spindle drive and two power resistors.

The resistors are switched on and off; as the rate of deceleration is increased, the resistors will be on for a short time and off for a longer time.

4.14 Gear Shifting

An intermediate shaft in the transmission is driven by the motor generating a 4.46 to 1 reduction in spindle speed. This occurs when the bull gear on the spindle axis engages with a pinion on the intermediate shaft. Declutching the direct drive to the spindle through a neutral position to pick up the 4.46:1 reduction gear is entirely automatic, thus spindle speeds are 120 to 1080 RPM in back gear and 1100 to 5000 RPM in direct drive. The neutral position can be selected for set-up purposes; it is a position in which the bull gear is neither engaged with the low speed pinion nor engaged with the direct drive clutch.

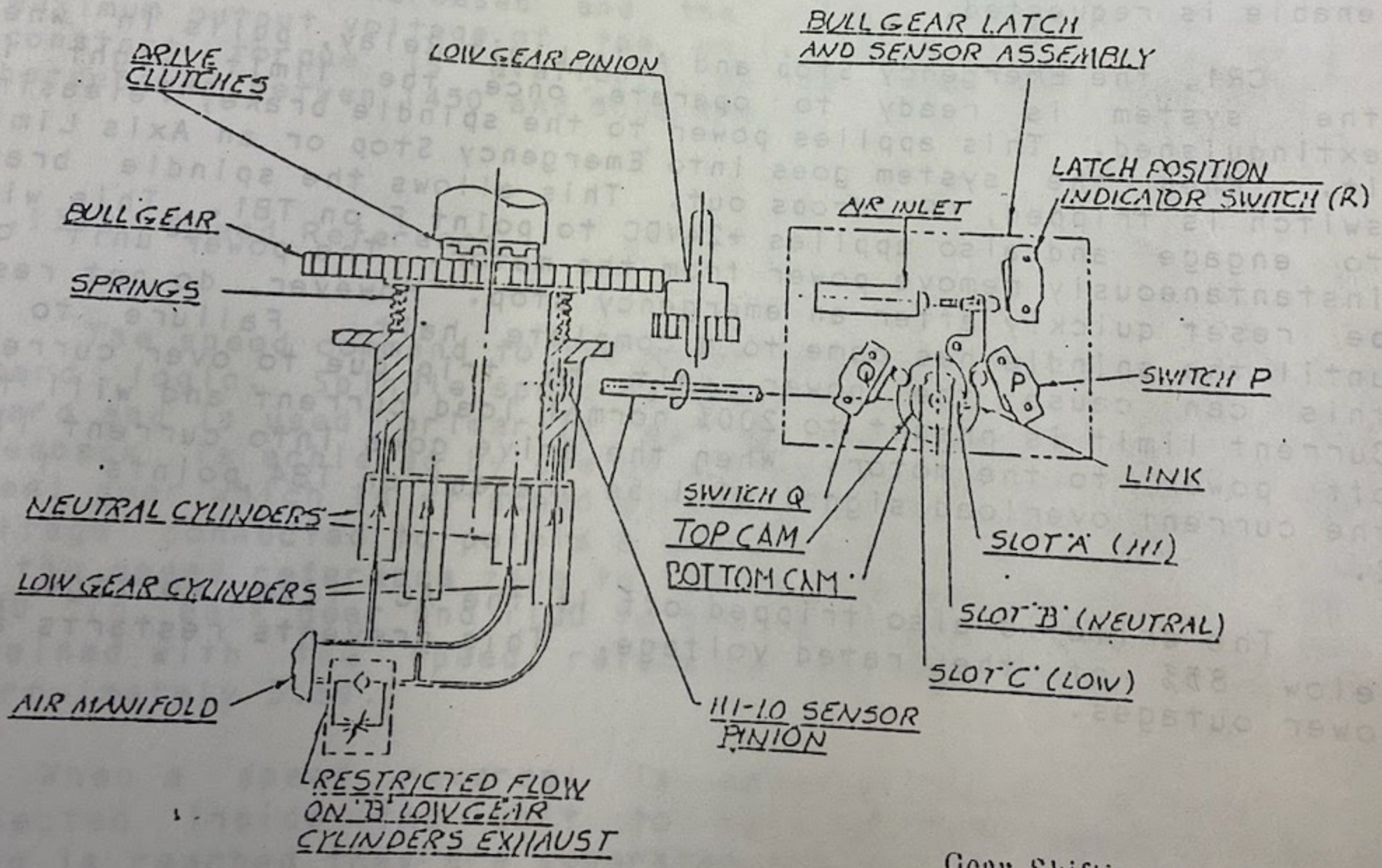
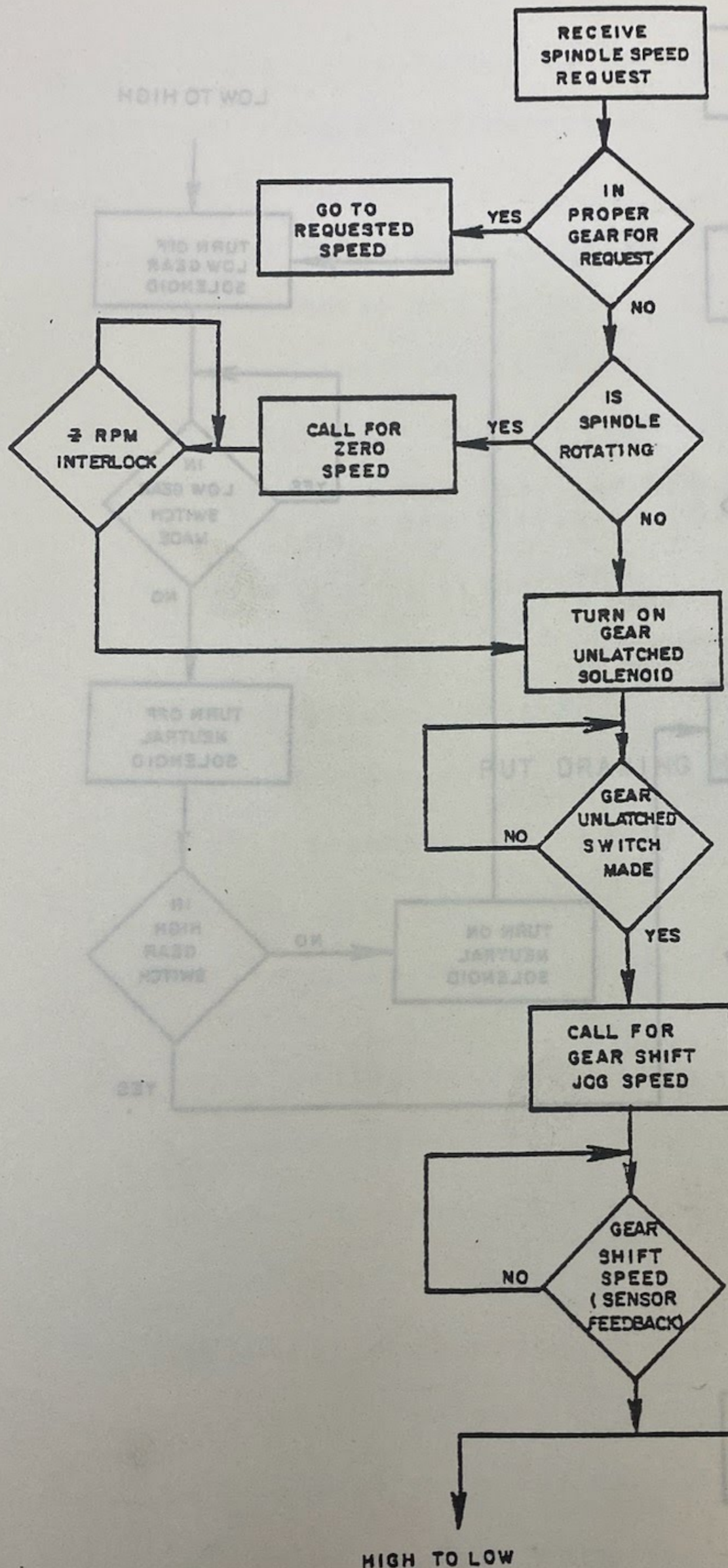


Figure 4-28 Gear Shifting

GEAR SHIFTING



STANDARD

LOW = 60 — 1090 RPM

HIGH = 1100 — 5000 RPM

TAPPING

LOW = 60 — 400 RPM

HIGH = 410 — 2000 RPM

Figure 4-29: Gear Shifting Flow Chart

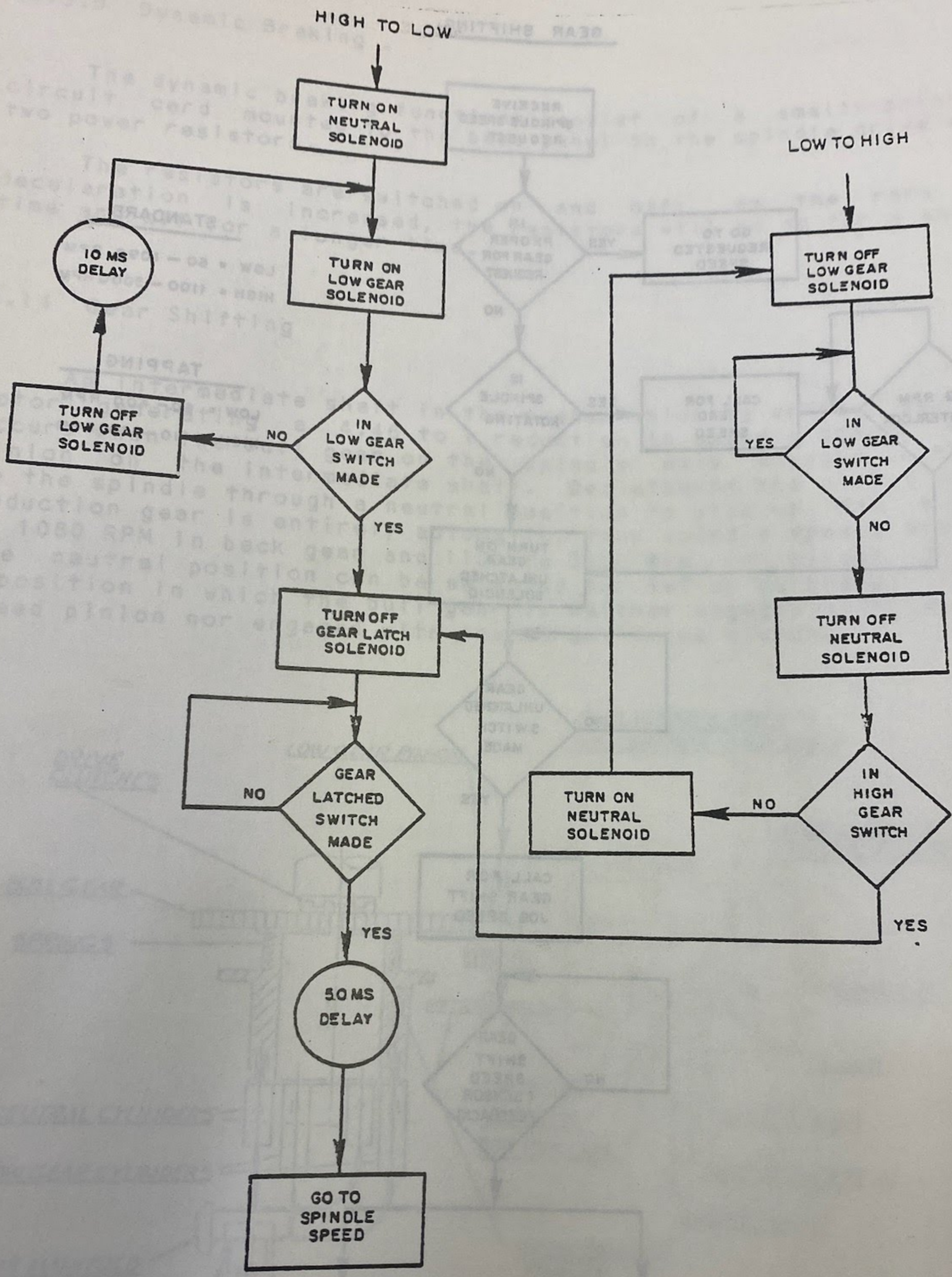


Figure 4-30: Gear Shifting Flow Chart Continued

4.15 TOOL CHANGING DISCUSSION

The tool changing operation is performed in two parts:

1. Old tool removal and carrousel alignment
2. Loading of new tool

The detailed steps are as follows:

1. Old tool removal and carrousel alignment
    1. Receive tool change command
    2. Stop and null spindle, send Z home
    3. Compare desired tool number with current tool number by reading the cam activated tool station position switches
    4. Enable ground plane
    5. Orient spindle
    6. Enable primary diaphragm
    7. Move rack arm (removing tool)
    8. Enable secondary diaphragm
    9. Replace old tool in carrousel
    10. Remove drive from rack arm

2. New tool loading sequence
    1. Rotate carrousel to the new tool
    2. Drive arm forward and select the newly positioned tool
    3. Insert tool in spindle
    4. De-energize secondary diaphragm
    5. De-energize primary diaphragm and ground plane to spind
    6. De-energize orientation
    7. Remove drive from rack arm

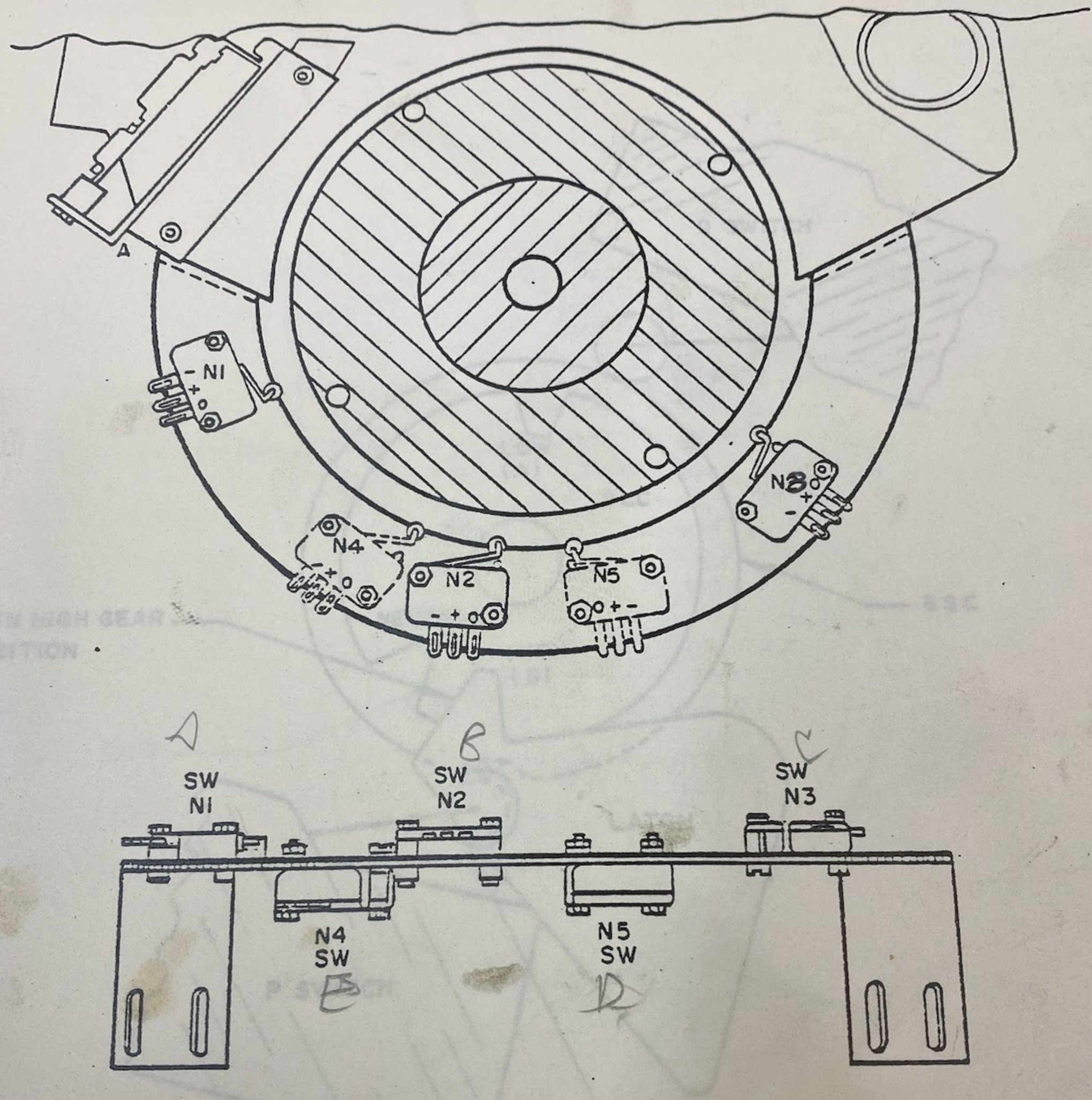


Fig 7-13 ENCODER SWITCHES

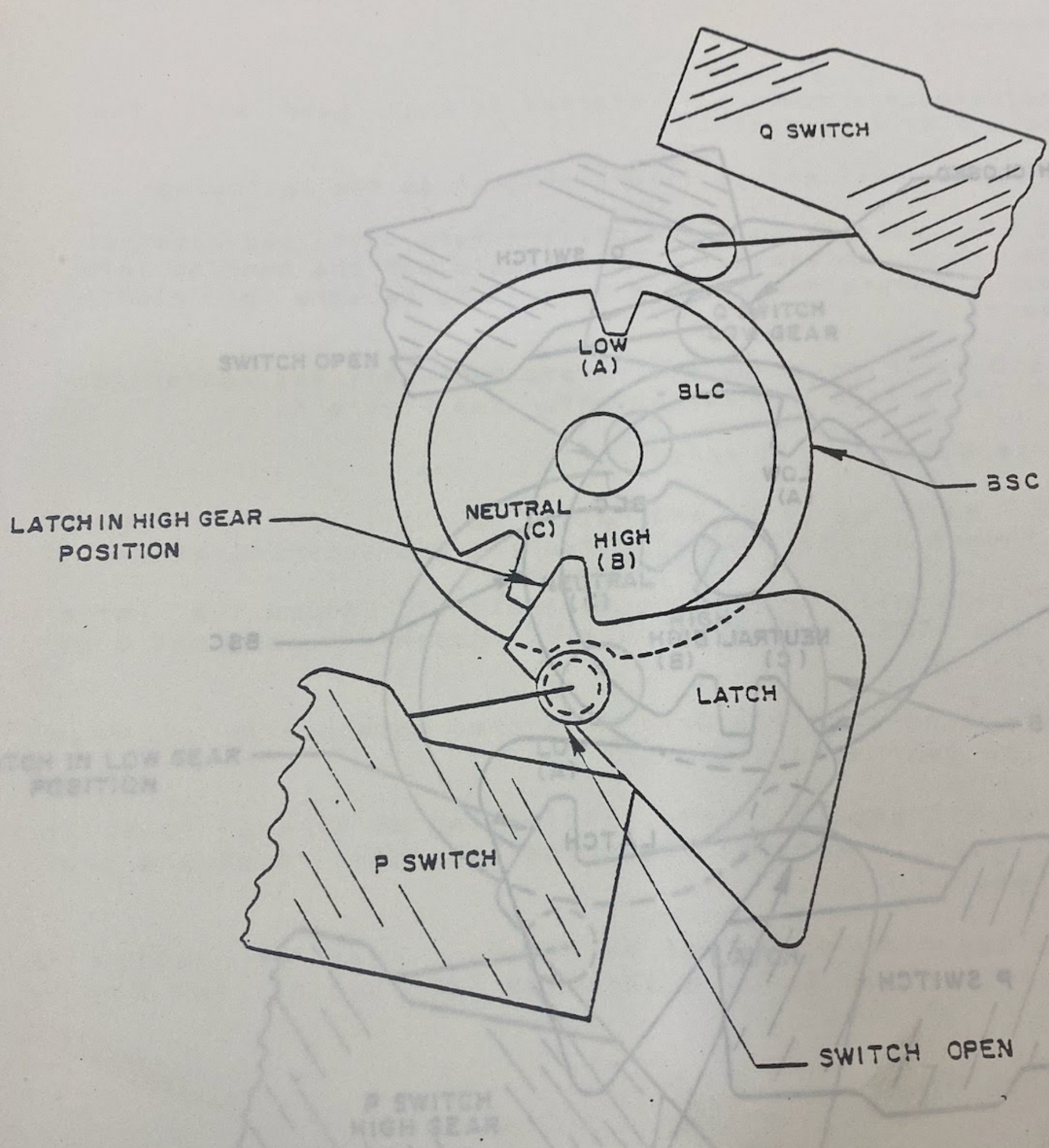


Figure 7-14: LATCH IN HIGH GEAR POSITION

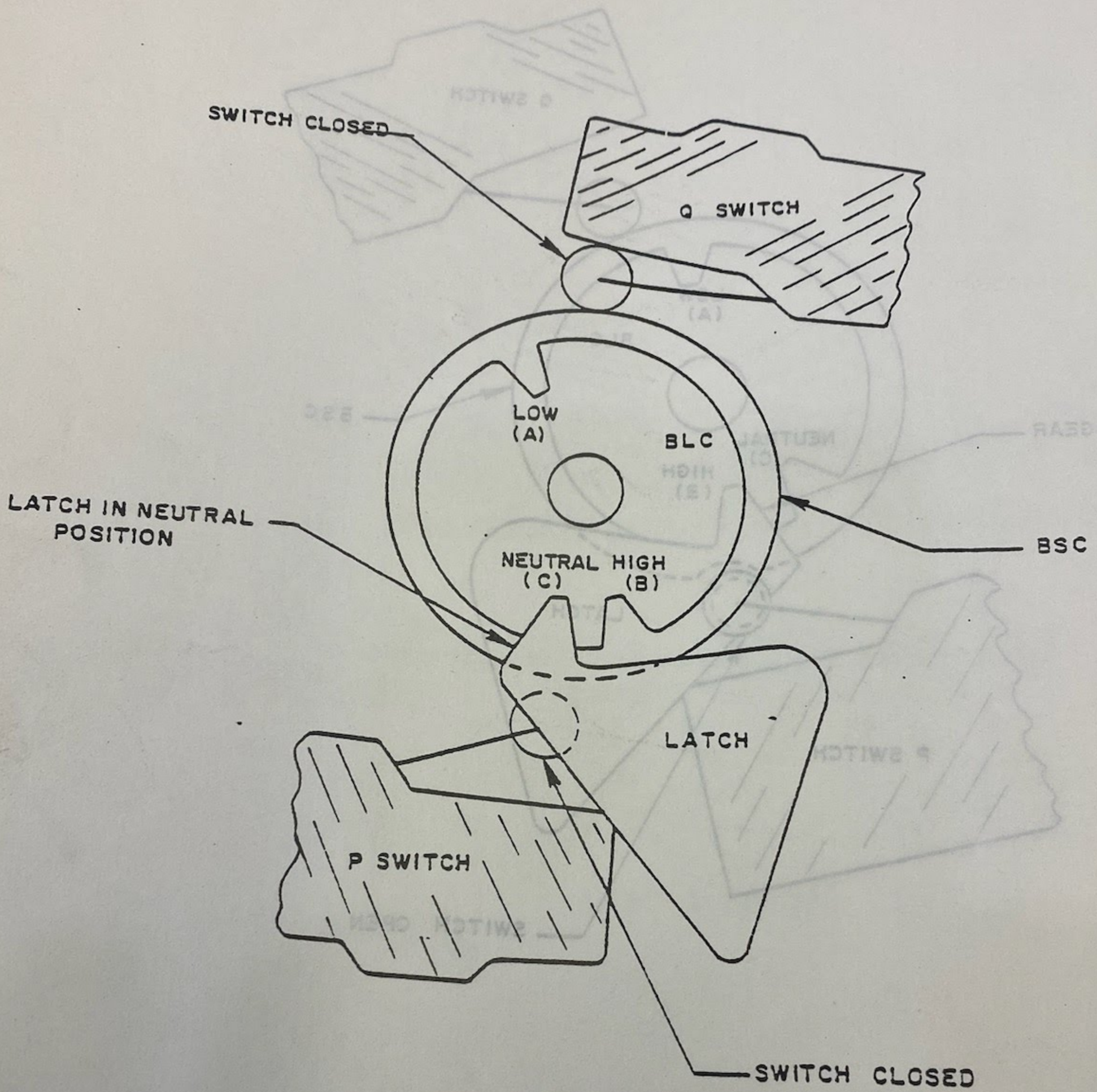


Figure 7-15: LATCH IN NEUTRAL POSITION

ADJUSTMENTS

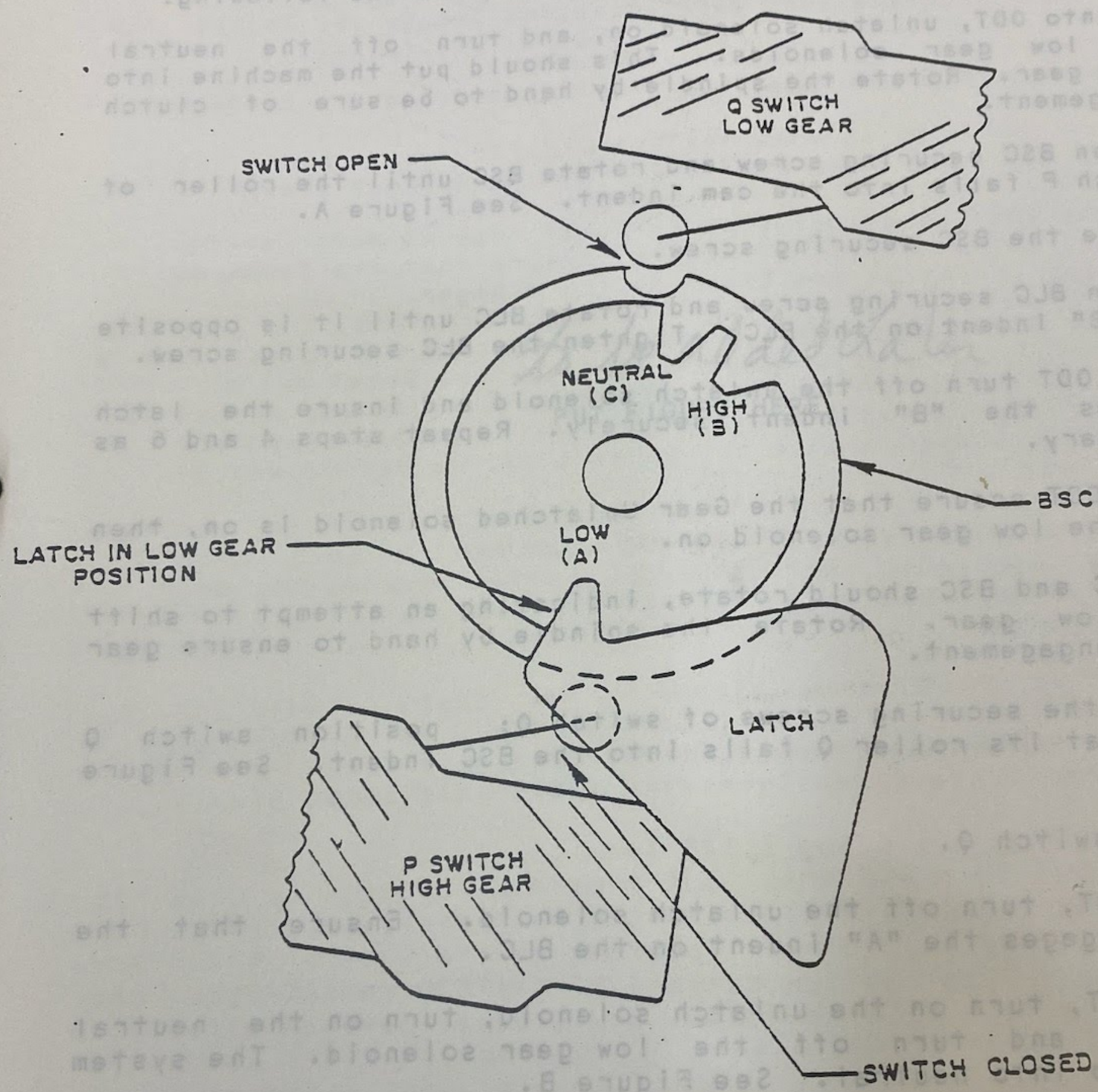


Figure 7-16: LATCH IN LOW GEAR POSITION

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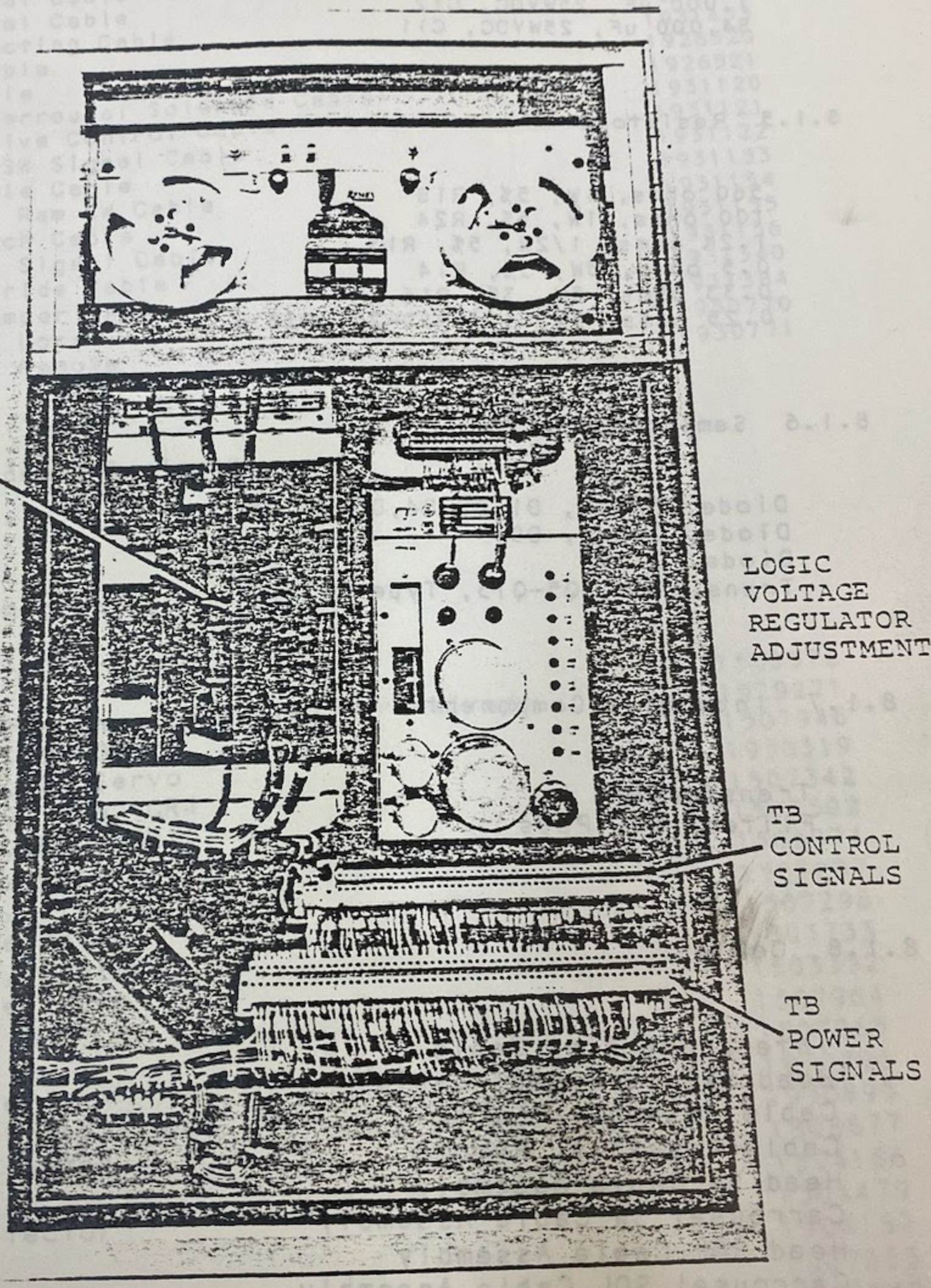
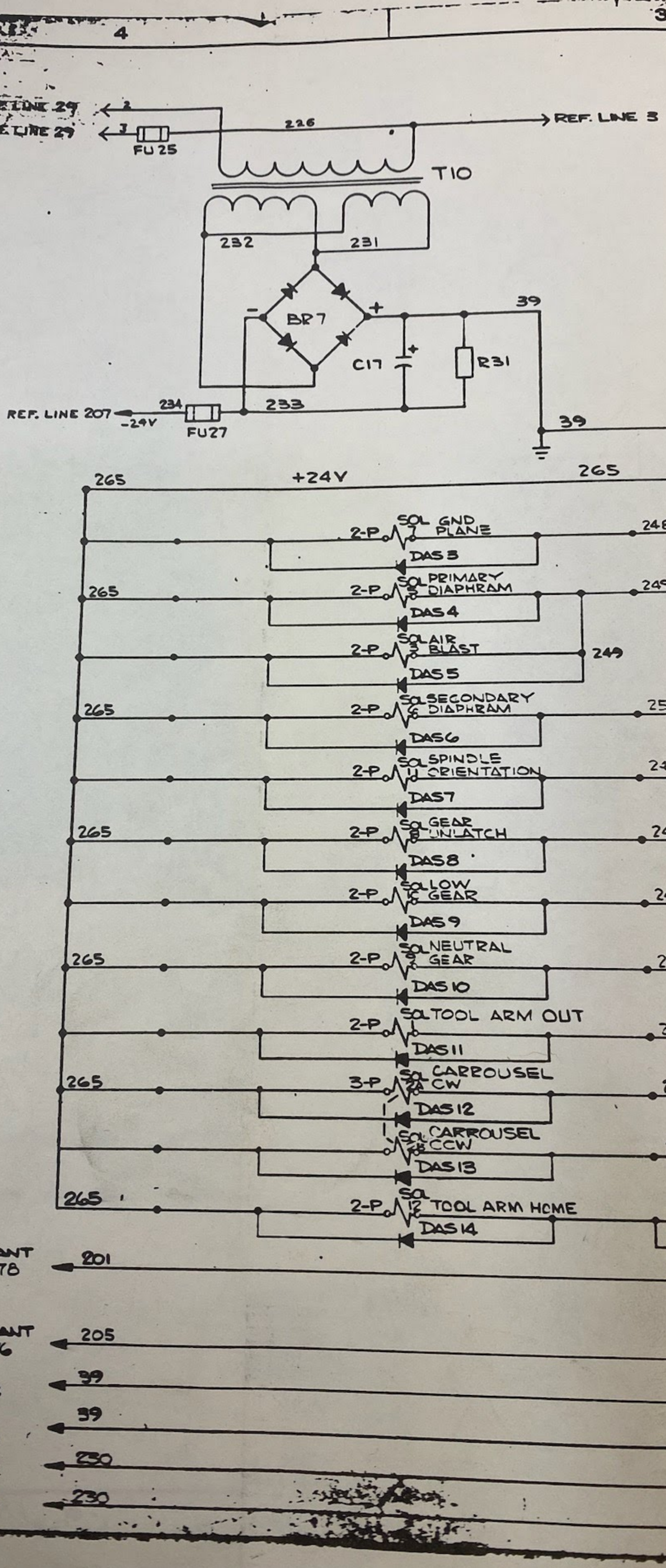
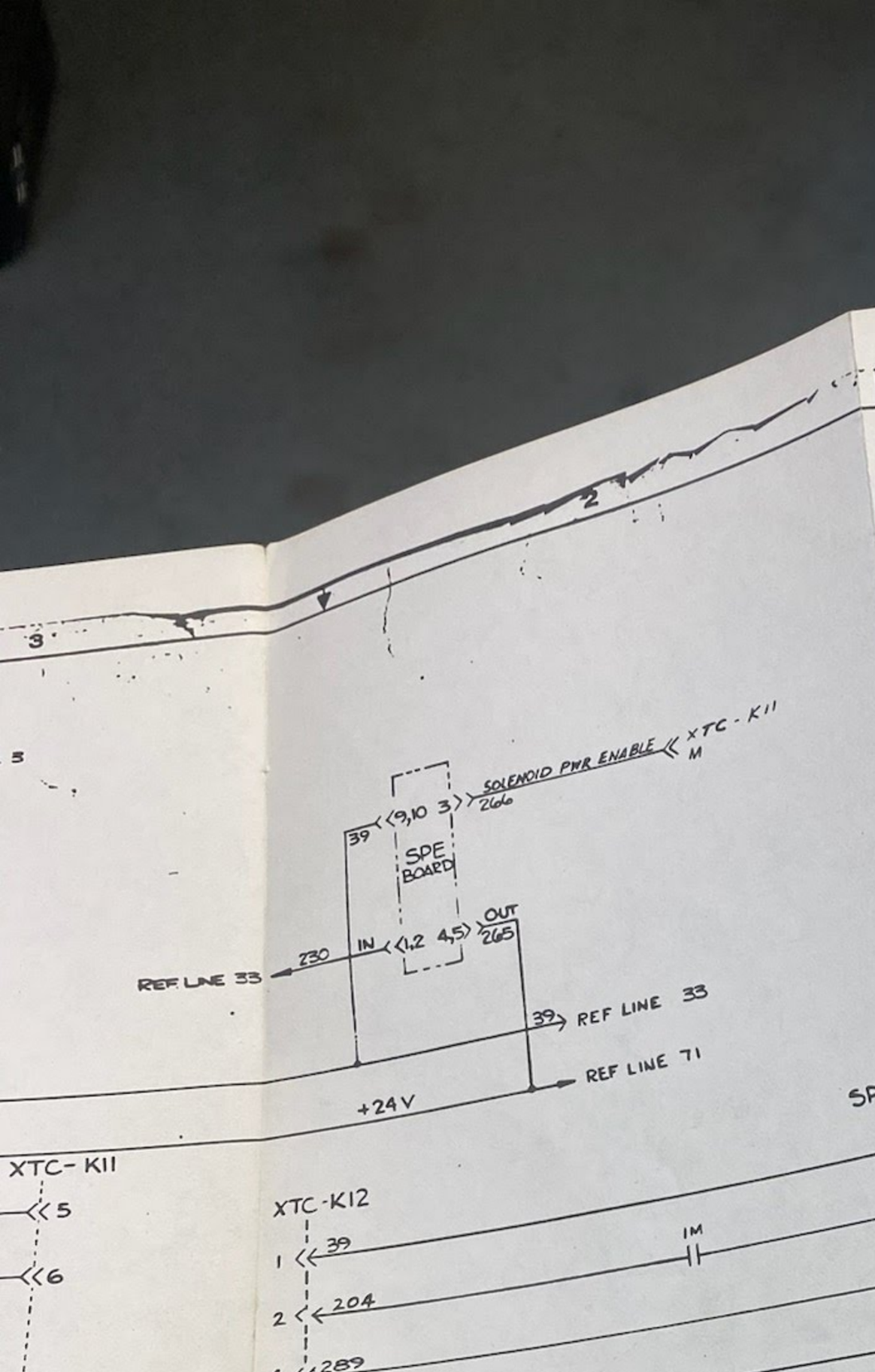


Figure 8-1: Control Equipment Enclosure with Component Identification


4
3
REF LINE 29
REF LINE 29
2
1
FU 25
226
REF. LINE 3
T10
232
231
BR7
C17
R31
39
REF. LINE 33
230
REF. LINE 207
-24V
234
FU27
233
39
+24V
265
XTC-K11
SOL GND PLANE
DAS 3
248
SOL PRIMARY DIAPHRAM
DAS 4
249
SOL AIR BLAST
DAS 5
SOL SECONDARY DIAPHRAM
DAS 6
250
SOL SPINDLE ORIENTATION
DAS 7
247
SOL GEAR UNLATCH
DAS 8
246
SOL LOW GEAR
DAS 9
244
SOL NEUTRAL GEAR
DAS 10
245
SOL TOOL ARM OUT
DAS 11
251
SOL CARROUSEL CW
DAS 12
252
SOL CARROUSEL CCW
DAS 13
299
SOL TOOL ARM HOME
DAS 14
101
REF LINE 74
2-P
3-P
SPRAY COOLANT
REF. LINE 278
201
FLOOD COOLANT
REF. LINE 276
205
GROUND
REF. LINE 33
GROUND
REF. LINE 33
REF. LINE 33
REF. LINE 33
XTC-K

D1933506



WIRE NOS.

2,3,39,101,204,205,226,230 THRU 234, 244 THRU 252, 265,266,288 THRU 291, 299.

LTR	REVISION	CHG'D	APPV'D	DATE
0	INITIAL RELEASE			6-24-81
	DCN NO.			

Bridgeport® TEXTRON

Bridgeport Machines Division of Textron Inc.

CONTROLS MANUFACTURING PLANT
200 Precision Road, Horsham, Pa. 19044

DESIGNED:	DATE:		
DRAWN: J.H. SEYBOLD	DATE: 81-25-02		
CHECKED:	DATE:		
APPROVED:	DATE: 6-24-81		
PROJECT NO. 846	MODEL NO. BTC		

DIMENSIONING
UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN MILLIMETERS
MM (INCH)
THIRD ANGLE PROJECTION
TOLERANCES
MM .X = ± ( )
ANGLE ,X = ± .5°

MATERIAL :
FINISH :
MARKING: PER A027099
TYPE: , CLASS: , POINT
REMOVE BURRS AND SHARP EDGES. INTERNAL CORNERS (.016) MAX.

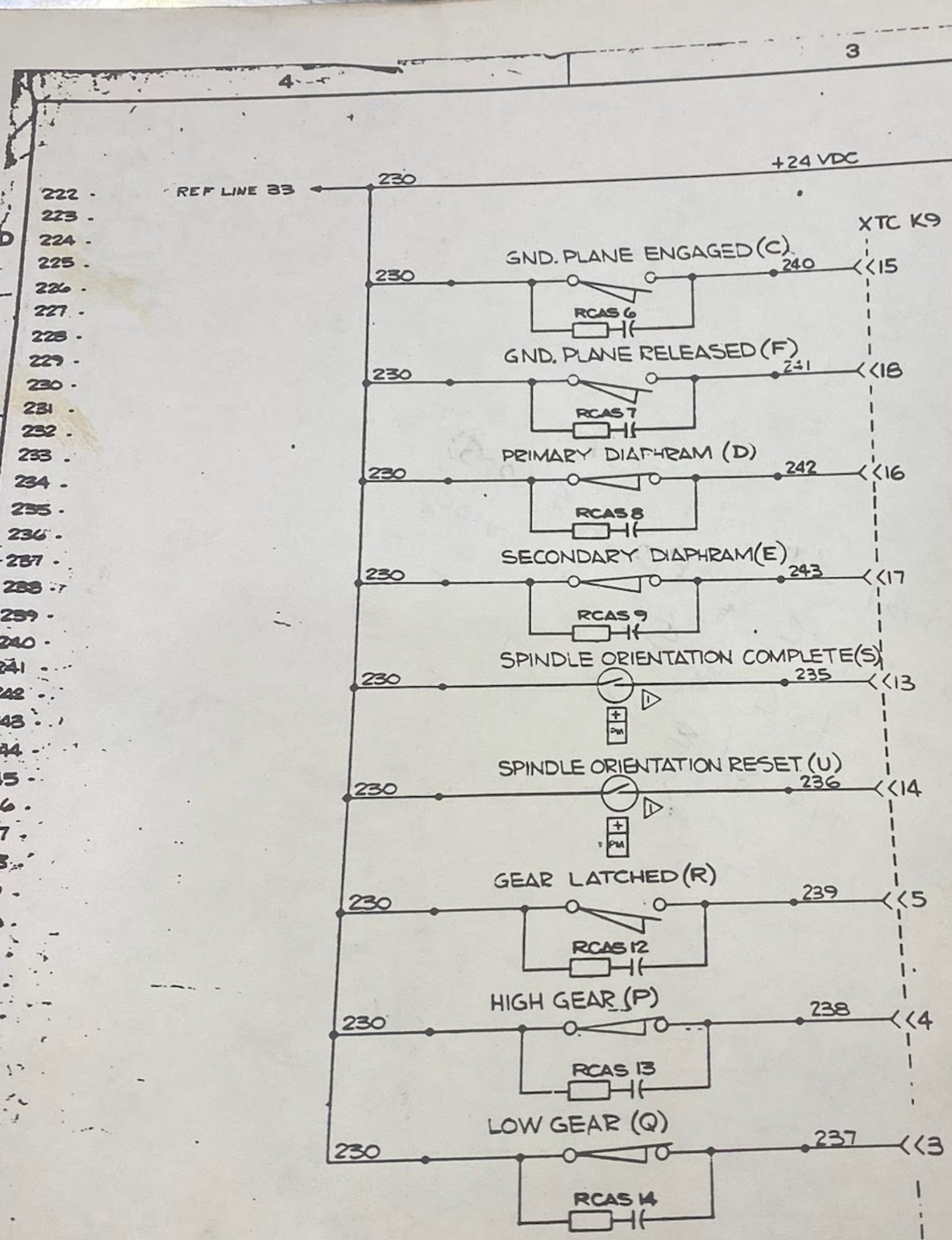
DWG NO. | PARTS LIST
NEXT ASSEMBLY

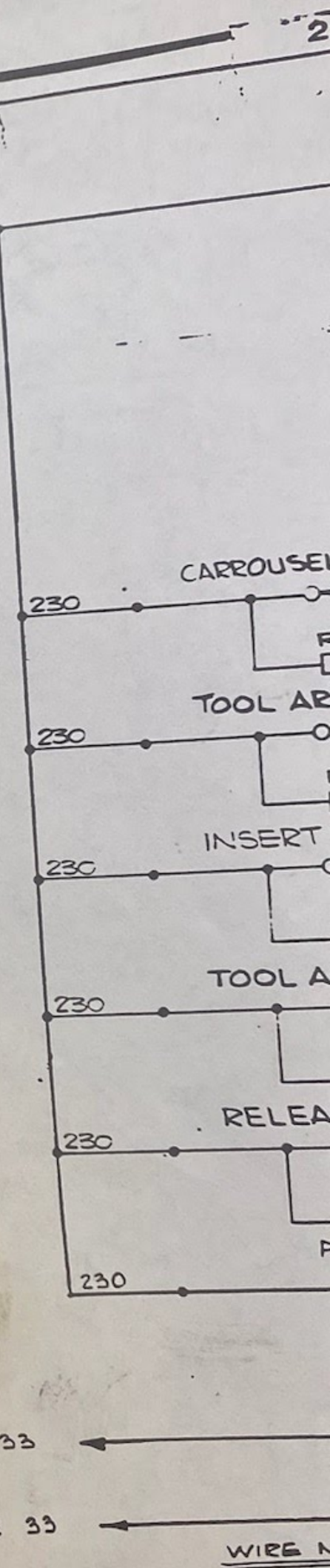
THIS DOCUMENT/DRAWING PROVIDES INFORMATION WHICH IS PROPRIETARY TO BRIDGEPORT MACHINES AND IS MADE AVAILABLE TO YOU FOR THE USE AND MAINTENANCE OF OUR PRODUCTS. ANY USE, REPRODUCTION, OR DISSEMINATION OF THIS INFORMATION FOR ANY OTHER PURPOSE IS PROHIBITED WITHOUT WRITTEN PERMISSION.

TITLE
SYSTEMS WIRING DIAGRAM
SERIES I-BTC LOW PROFILE

SIZE	CODE IDENT NO.	DWG NO.	REV.
D		1933506	0

SCALE : DO NOT SCALE DWG — SHEET 6 OF 8





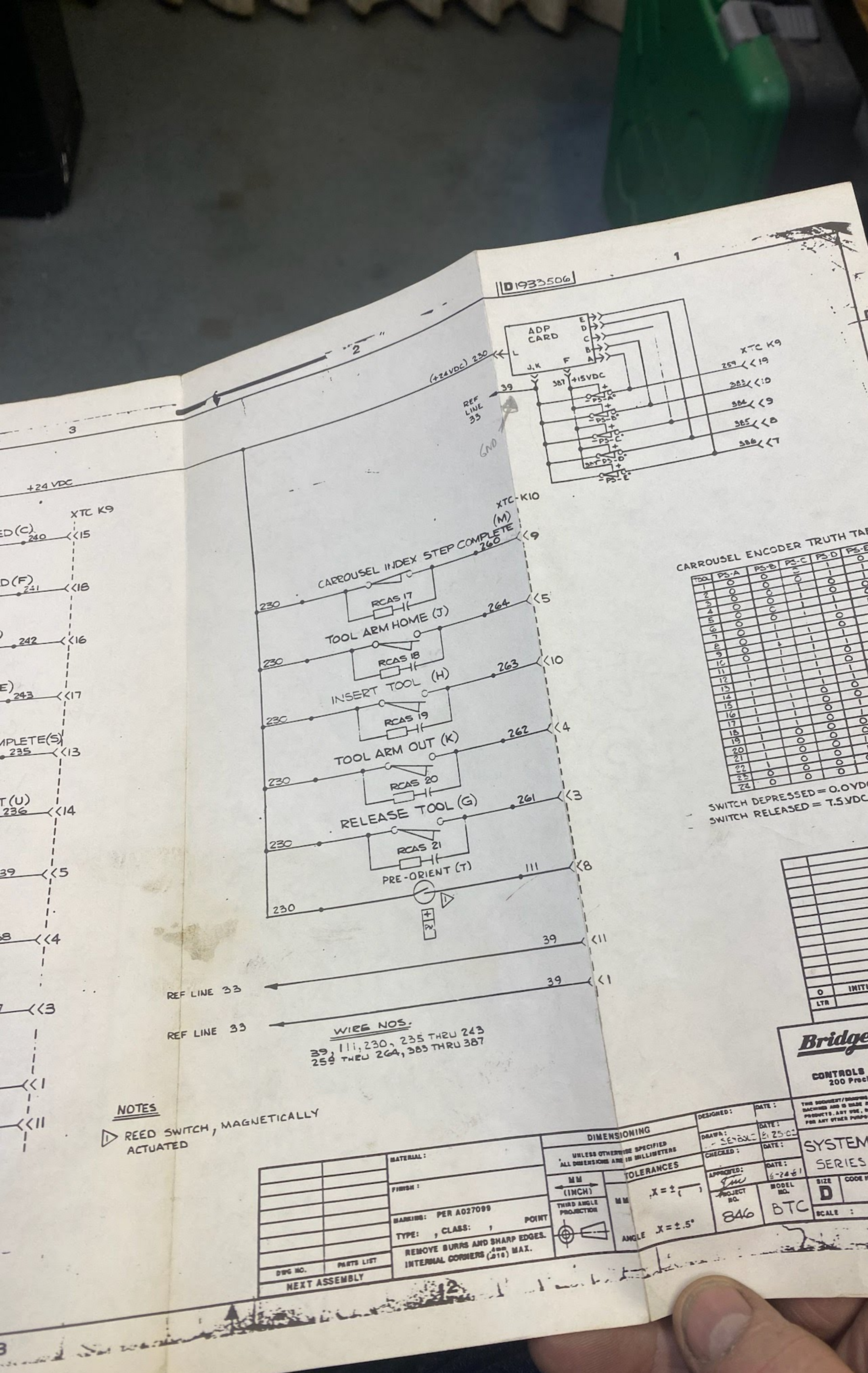
WIRE N
39, 111, 230
259 THRU 2

NOTES

1. REED SWITCH, MAGNETICALLY ACTUATED

DWG NO.	PART
NEXT ASSEMB	

D1933506



CARROUSEL ENCODER TRUTH TABLE

TOOL	PS-A	PS-B	PS-C	PS-D	PS-E
1	0	0	0	1	0
2	0	0	0	1	1
3	0	0	1	0	0
4	0	0	1	0	1
5	0	1	0	1	0
6	0	1	0	1	1
7	0	1	1	0	0
8	0	1	1	0	1
9	0	1	1	1	0
10	0	1	1	1	1
11	1	0	0	0	0
12	1	0	0	0	1
13	1	0	0	1	0
14	1	0	0	1	1
15	1	0	1	0	0
16	1	0	1	0	1
17	1	0	1	1	0
18	1	0	1	1	1
19	1	1	0	0	0
20	1	1	0	0	1
21	1	1	0	1	0
22	1	1	0	1	1
23	0	0	0	0	0
24	0	0	0	0	0

SWITCH DEPRESSED = 0.0 VDC ON "O" TERMINAL
SWITCH RELEASED = T.5 VDC ON "O" TERMINAL

LTR	REVISION	CHG'D	APP'D	DATE
0	INITIAL RELEASE DCN NO.			6-24-81

Bridgeport® TEXTRON
Bridgeport Machines Division of Textron Inc.
CONTROLS MANUFACTURING PLANT
200 Precision Road, Horsham, Pa. 19044

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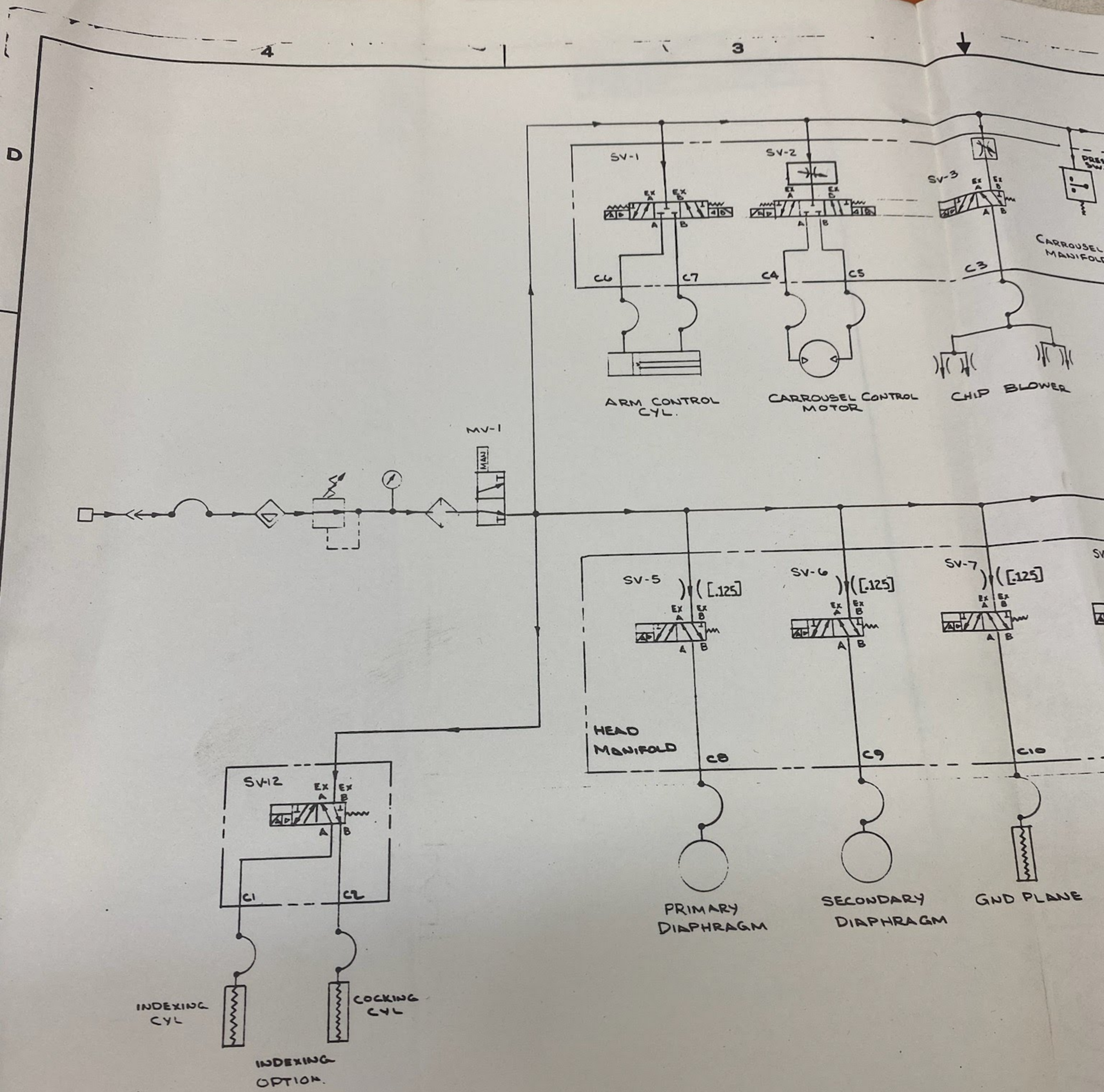
DESIGNED:		DATE:
DRAWN: SENDLE		DATE: 6-25-81
CHECKED:		DATE:
APPROVED:		DATE: 6-24-81
PROJECT NO. 846	MODEL NO. BTC	

TITLE
SYSTEMS WIRING DIAGRAM
SERIES I - BTC LOW PROFILE

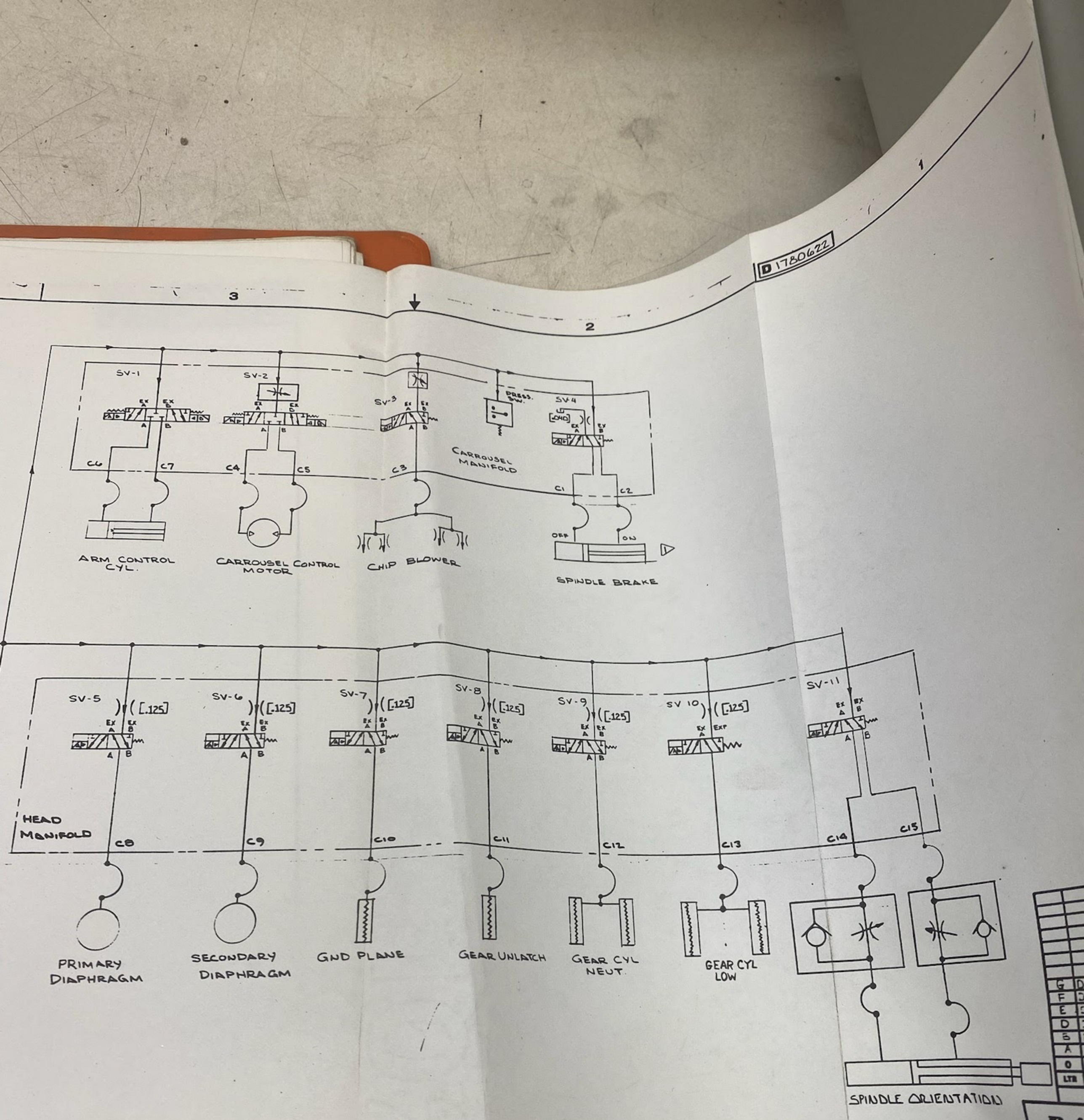
SIZE	CODE IDENT NO.	DWG NO.	
D		1933506	
SCALE : DO NOT SCALE DWG		SHEET 7 OF	

MATERIAL:	DIMENSIONING UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN MILLIMETERS	
FINISH:	TOLERANCES MM (INCH)	
MARKING: PER A027099	THIRD ANGLE PROJECTION	MM .X = ± ( ) ANGLE .X = ± .5°
TYPE: , CLASS: , POINT		
REMOVE BURRS AND SHARP EDGES. INTERNAL CORNERS (.016) 4mm MAX.		
DWG NO. / PARTS LIST		
NEXT ASSEMBLY		



1 PNEUMATIC BRAKE ONE MACHINE ONLY
REPLACE WITH INDEX OPTION.

D 17806 22



		MATERIAL :	DIMENSIONING	DESIGNED: AJR	DATE: 79-11-05	Bri	
		FINISH :	UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN MILLIMETERS	DRAWN: AJR	DATE: 79-11-06		
		MARKING: PER A027099	MM (INCH)	CHECKED: AJR	DATE: 79-11-06		
		TYPE: , CLASS: , POINT	THIRD ANGLE PROJECTION	APPROVED:	DATE: 7/4/06		
DWG NO.	PARTS LIST	REMOVE BURRS AND SHARP EDGES. INTERNAL CORNERS (.4mm .016) MAX.	TOLERANCES: MM .X = ± ( ) ANGLE .X = ± .5°	PROJECT NO. 846	MODEL NO. I-BTC		
NEXT ASSEMBLY							

SCHEMATIC XTC BOARD

1930760

REL FOR PRODUCTION

POWER SECTION COMPLETELY ISOLATED FROM LOGIC SECTION

DRAWN	7-94-02
CHECKED BY	
APPROVED BY	
SUBMITTED:	
APPROVED:	
SCALE	
UNIT WT.	
SIZE	D
CODE	
DRAWING NO.	1930760
SHEET 1 OF 1	
REV	E

UNLESS OTHERWISE SPECIFIED
REMOVE BURRS & SHARP EDGES
EXTERNAL CORNERS .015 R. MAX.
FINISH ALL OVER
APPLY PART NO.
CHARACTERS
METHOD
DO NOT SCALE DRAWING
TOLERANCES ON DECIMALS ±
ANGLES ±
FRACTIONS ±
MATERIAL:
HEAT TREATMENT:
PROTECTIVE FINISH:
NEXT ASSY
APPLICATION

K11

+24V$_1$

+24V$_2$

FROM LOGIC SECTION

M-144

OPERATING MANUAL

FOR THE

SERIES I BTC

MACHINING CENTER

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September 1980

Bridgeport® TEXTRON

Bridgeport Machines Division of Textron Inc.

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PROGRAMMING MANUAL

FOR THE

SERIES I BTC

MILLING, DRILLING & BORING MACHINE

WITH

BOSS 7.1 SOFTWARE

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M-147

INSTALLATION MANUAL

FOR THE

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K9-6.

5. The speed reference voltage adjustment (P1) is made as follows:

   1. Set the spindle speed to 2000 RPM.

   2. Using a hand held tachometer, adjust P1 until the spindle runs at 2000 RPM.

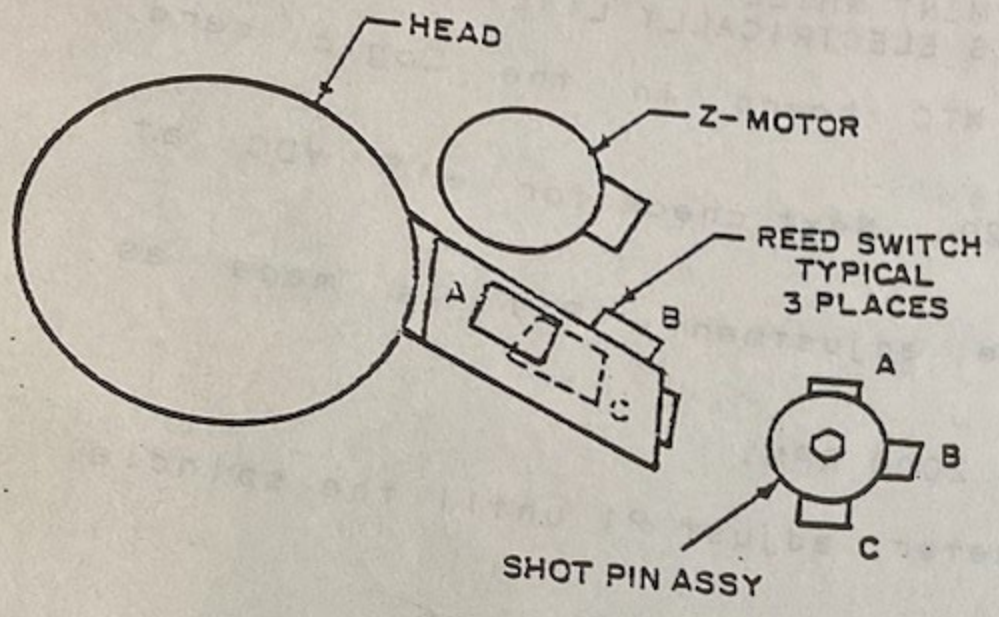
7.8 Orientation Set-up

1. With power off to the control and no air connected, preset the two orientation regulators to the off state (full counterclockwise).

2. Connect the main air supply to the control and verify a setting of 75 PSI at the line regulator.

3. Adjust the orientation reset regulator (port C15 on the head manifold) for 25 to 30 PSI (hose closest to the head on the shot pin cylinder).

4. Turn power on to the control. Place the system in the SETUP state. Manually turn the spindle until the key faces the column.



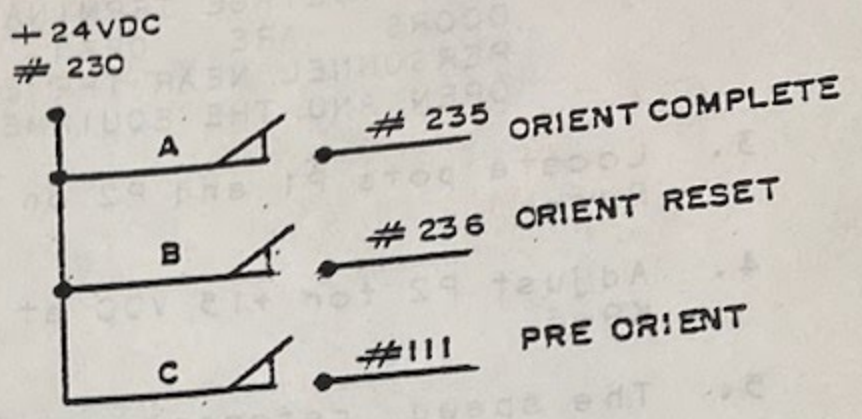


Figure 7-7:

5. Loosen the set screws securing the 3 reed switches and slide the switches as far back from the head as the track will allow.

6. Locate wire #236 and #230 in the Control Enclosure on the terminal tracks and place a VOM across #230 (plus) and #236 (minus). You will be measuring +24 VDC.

7. Locate switch U and read the meter to determine if the switch is closed.

   0.0V = closed
   24V = open

8. Move switch U in towards head until the switch closes. Move it approximately 1/8" further and secure it in this positive.

9. Verify that the machine is in low gear.

10. Connect a terminal to the local port, remove K7 from the RRS card and enter ODT by pressing the BREAK key.

11. Enter: 171206/
    Result: 171206/100001
    Enter: 0 (ZERO)
    Result: Orientation solenoid should energize

12. Adjust the regulator for shot-pin out (C14 on the head manifold) for 20 PSI.

    1. The shot-pin should engage the scroll plate

13. Manually rotate the spindle clockwise for approximate 90 degrees. The shot-pin shoud extend further due to the scroll plate step-off. You can feel the step off with your hand on the spindle.

14. Rotate the spindle counterclockwise until it stops.

15. Locate wires #111 and #230 on the terminal track in the Control Enclosure and place a VOM across #230 (plus) and #111 (minus). You will be measuring +24 VDC.

16. Move switch T in towards the head until the switch closes; move it approximately 1/8" further and secure it in this position.

17. Manually rotate the spindle clockwise to the keylock position. The shot-pin should extend into the keylock slot. You will not be able to rotate the spindle if it is in keylock.

18. Locate wires #235 and #230 on the terminal block in the Control Enclosure and place a VOM across #230 (plus) and #235 (minus). You will be measuring +24 VDC.

19. Move switch S in towards the head until the switch closes; move it approximately 1/8" further and secure it in this position.

20. Enter: 171206/
    Result: 171206/000000
    Enter: 1 (one) then hit the RETURN key
    Result: Shot-pin should retract.

21. Manually attempt to rotate the spindle in both directions. The spindle should rotate smoothly with no interference from the shot-pin.

22. Exit from ODT by pressing "P". Reconnect K7 on the RRS card. Rotate the spindle CW 90 degrees.

23. Place system in the Power Enable state.

24. Enter: M19 EOB (in MDI Mode)
    Result: System should correctly orient
    Enter: G86F300S2000M3X0Z1.5 EOB
    Result: System should change gears and orient correctly
    Verify: Correct cycle operation per Manual M-165, Section 5.

2.4 Orientation

Spindle orientation is done mechanically as part of a tool change cycle or by special command and can take place in any quill position. Orientation command will force the machine to go to low gear and allow the spindle drive motor to rotate the spindle at low speed. When minimum speed is detected, an air valve shifts to drive the piston of an air cylinder full stroke. The piston rod carries a shot pin to engage in a slot in a scroll plate attached to the bull gear. Advance of the shot pin into the orientation slot also removes the spindle speed command from the spindle drive motor. Refer to Figure 2-4.

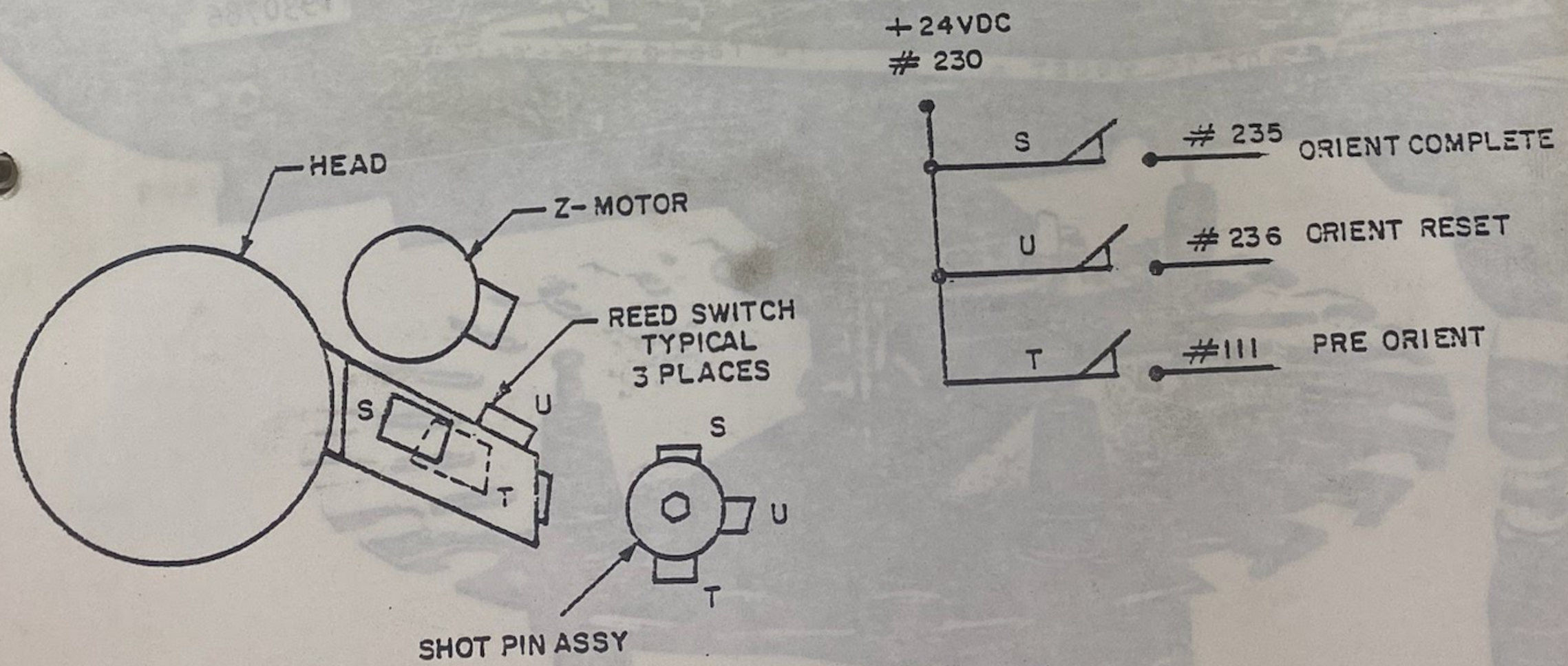


Figure 2-4: Orientation

2.5 Tool Rack Carrousel

This is a 24 position circular rack driven by a bidirectional air motor. Refer to Figure 2-5. The motor drives a Geneva mechanism with a position detection system. The detection system includes an encoder which determines the absolute position of the carrousel and aids in the search for a particular tool. The direction of rotation is automatically selected with the tool change cycle achieving random selection by the shortest path.

The carrousel can also be indexed while in Manual Setup operation. A pushbutton is located at the back of the machine for manual indexing but dual interlocks are provided to prevent simultaneous automatic carrousel action. Power enable is possible only when the tool shield is in position.

An empty slot must be presented to the tool change arm if there is a tool in the machine spindle. 3" diameter tools are easily accommodated; however, if 4" tools are used they must be placed between 2 tools of 2" diameter or empty slots.

There is a special air blast directed upon the taper of the old tool entering the carrousel and on the taper of the new tool as it leaves the carrousel for the spindle. This ensures a clean, positive, contact with the spindle taper.

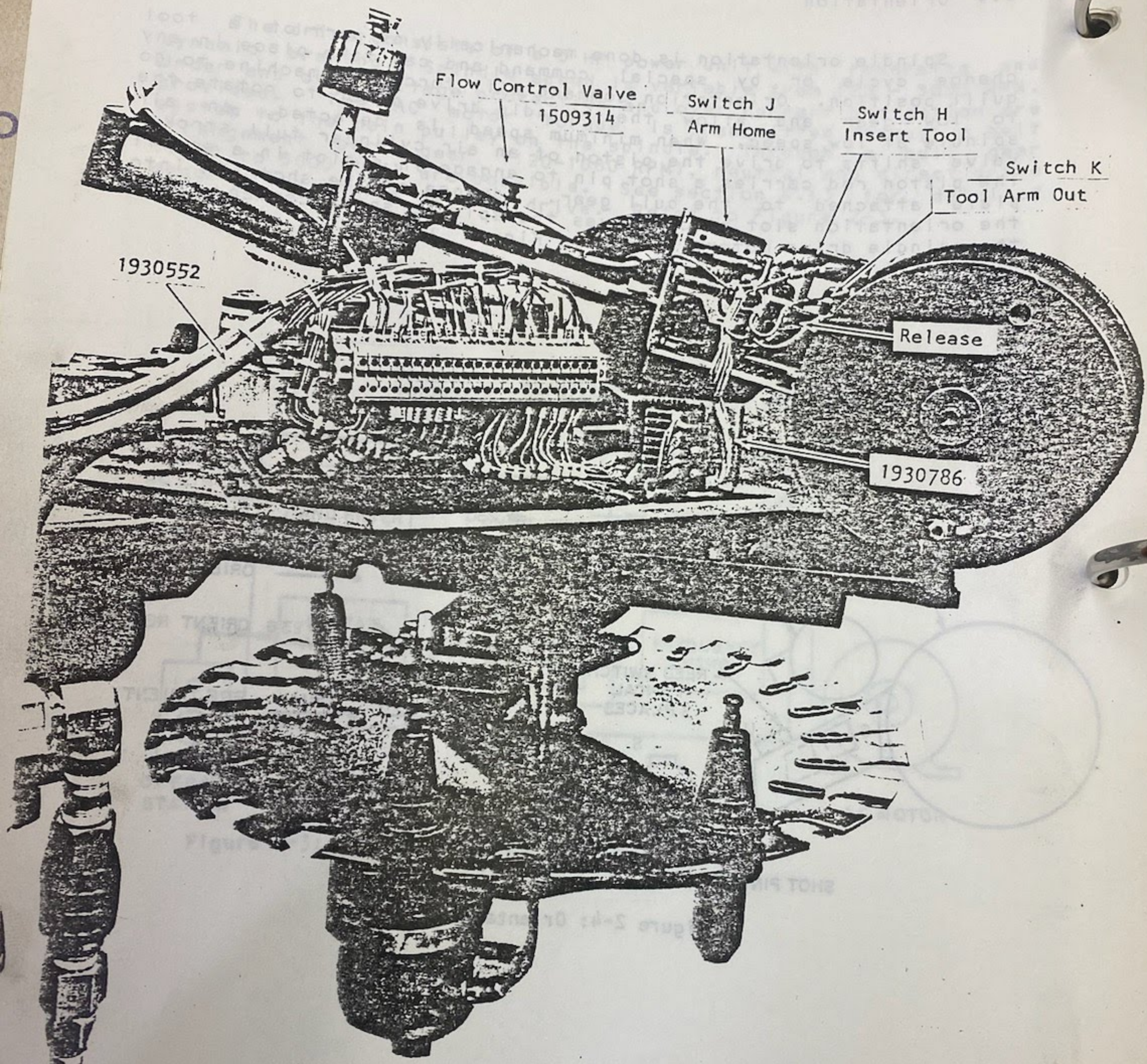


Figure 2-5: Tool Arm Carrousel

[redacted]

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(206) 424-8095

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MACHINING CENTER

WITH

(BOSS 7.2 Software)

MAINTENANCE MANUAL

M-168

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