K&S #4124

THERMOSONIC GOLD BALL BONDER

OPERATION MANUAL

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1. INTRODUCTION

The Model 4124 Thermosonic Ball Bonder (Fig.1-1) is a new machine that embodies a number of features and capabilities already proven in the Model 4123 Wedge Bonder.

1.1 The following features are new on the Model 4124 Ball Bonder:

1.1.1 Three solenoids control wire feed:

DRAG SOLENOID operates the drag clamp, seating the ball against the capillary tip before the first bond.

KICKER SOLENOID throws the kicker forward against the wire, pulling wire off the spool.

CLAMP SOLENOID operates the wire clamp, opening and closing the clamp on signals from the logic board or the CLAMP switch. The clamp closes after the second bond so that the rise of the bonding head will tear the wire from the second bond.

1.1.2 ELECTRONIC FLAME-OFF (EFO) melts the end of the wire tail to form a ball by generating an arc between the EFO electrode and the wire. The BALL SIZE ADJ. selector on the front cover of the main head selects the charge on the electrode under the wire tail in response to the flame-off signal from the logic board.

1.2 The following features, proven on the Model 4123 Wedge Bonder, are embodied in the Model 4124 Ball Bonder:

1.2.1 DC SERVO/LVDT CLOSED LOOP CONTROL of the bonding head means maximum speed between positions, with gradual starts and stops, minimum jarring and vibration, and high precision of vertical placement. Only one cam is required, with all sequence and timing functions controlled by electronic logic.

1.2.2 PHASE-LOCKED-LOOP (PLL) ULTRASONIC GENERATOR & HIGH-q TRANSDUCER. The high-Q TRANSDUCER is sensitive to changing load during bonding and the PLL circuit enables the generator to track the resonant frequency of the ultrasonic circuit so that the bonding power is always delivered to the bond at the instantaneous resonant frequency of the system. This means maximum efficiency, minimum power requirement and close control of the bonding process.

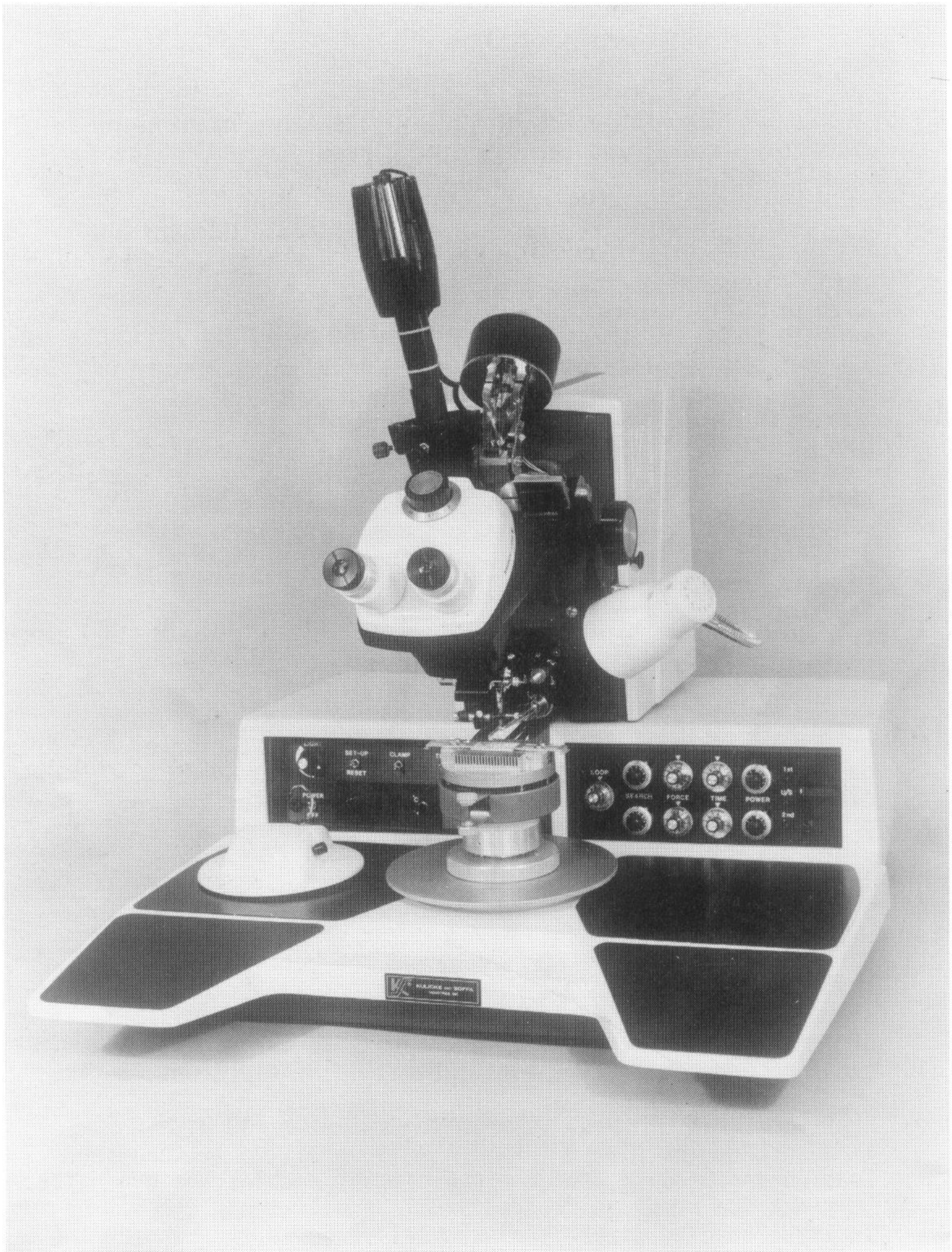


FIGURE 1-1   MODEL 4124 BALL BONDER

1.2.3 ELECTRONIC DIAL CONTROL of bond forces, U/S powers, search and loop heights and bonding duration.

1.2.4 AIR-DAMPED BONDING HEAD stabilizes the bonding head against shock and vibration and insures soft-touch impact.

1.2.5 WORKHOLDER TABLE permits a 3.75” x 3.75” (95 mm x 95 mm) access of bonding area.

1.2.6 CHESSMAN with 6:1 reduction for fine positioning of the device under the microscope.

1.2.7 CHESSMAN BUTTON for semi-automatic bonding: press to bring capillary near focus at SEARCH height, release to complete a bond.

1.2.8 STITCH BUTTON held in after 1st bond permits incorporation of one or more safety stitch bonds in the bonding cycle. After STITCH BUTTON is released, the cycle accomplishes the “2nd bond”.

1.2.9 OVERHEAD MICROSCOPE permits full horizontal access to the work area.

1.2.10 TEMPERATURE CONTROLLER K&S Model KTC-101 (type J) controls and displays digitally the temperature of the workholder.

1.3 The optional features are:

1.3.1 TWO-IN-ONE OPERATION: Depending on the device, select either of two bonding modes:

CHESSMAN high-speed semi-automatic bonding where height difference between 1st and 2nd bonds is up to 0.28” (7.1 mm).

MANUAL Z bonding for accurate positioning: lower the Z-lever to accomplish the 1st bond; lower lever again to make 2nd bond. Finally, the head rises automatically to RESET.

1.3.2 SPOTLIGHT facilitates targeting by projecting a ring-shaped spot of light onto the bond site.

1.3.3 WORKHOLDERS of the stationary or rotary, heated types.

1.3.4 REVERSE BOND KIT permits stitch bonding in the 1st bond parameters.

HOW TO USE THIS MANUAL

Before operating the Model 4124 Ball Bonder, read sections 1 through 8 in order. Follow the instructions carefully. You will be rewarded by fast, efficient performance. Sections 9 (troubleshooting), 10 (parts list) and 11 (electronics) will be helpful for diagnosing and correcting malfunctions. If you need further help, K&S factory-trained experts are at your service. Section 12 (accessories) can be used as a reference file for specification sheets and bulletins describing K&S MICRO-SWISS accessories for your bonder.

2. SPECIFICATIONS *

WIRE

Diameter range	0.7 to 3.0 mils (17 to 75 microns)
Spool	TC-3 2" (50.8 mm) dia. single flange
Material	Gold

PERFORMANCE

Cycle time	900 ms (incl 100 ms bond time)	
Bond force	5 to 160 gr	
Bond time	10 to 100 ms	
Ultrasonic power	Low	1.3 W. max.
	High	2.0 W. max.
EFO	1200 Vdc, adjustable ball size	

MACHINE

Throat depth	5" (127 mm)	
Reset to overtravel overall range	0.33" (8.38 mm)	
Search/Loop height range	0.02" (0.51 mm) under RESET to:	
	0.02" (0.51 mm) above lowest OVERTRAVEL	
Table motion	Gross	6.5" (165 mm) dia.
	Fine	0.5" (12.7 mm) dia.
Bonding area	3.75" x 3.75" (95 mm x 95 mm)	
Chessman ratio	6:1	
Tail length	Constant, electronically adjustable	
Optics	B&L or WILD stereo zoom microscope, top mounted	

OPTIONS

Spotlight targeting	Motorized workholders
Adjustable-height heated workholder	Manual Z system
All standard K&S manual workholders	Reverse bond kit

TEMPERATURE CONTROLLER KTC-101

Thermocouple input	Type J (Iron-Constantan)
Indicating range	0ºC to 400ºC
Set-point range	+50ºC to +400ºC
Zero offset	±45ºC total change
Accuracy	035% of full scale @ +25ºC ambient temperature
Operating temperature	0ºC to +50ºC
Cold junction compensation	0ºC to +50ºC ambient temperature

* Specifications are subject to changes without prior notice.

TEMPERATURE CONTROLLER KTC-101 (continued)

Line Voltage	KTC-101-1	115 Vac	+10% to –20%
	KTC-101-2	230 Vac	50 to 60 Hz
Load Output	KTC-101-1	4 A, 115 Vac	
	KTC-101-2	4 A, 230 Vac	
Protection	Triac protected by internal fuse 4 A fb		

ELECTRICAL REQUIREMENTS

Voltage	100/120/220/240 Vac ±10%
Frequency	50 to 60 Hz
Power	70 VA max

PHYSICAL DIMENSIONS

	Machine	Shipping
Depth	26" (660 mm)	29.1" (740 mm)
Width	23.5" (597 mm)	26.8" (680 mm)
Height	26" (660 mm)	27.2" (690 mm)

WEIGHT

Machine	64 lb (29 kg)	without
Shipping	110 lb (50 kg)	accessories

3. PHYSICAL DESCRIPTION

3.1 BONDING PARAMETERS' CONTROLS consist of nine dials in the right control panel (Fig 3-1, 4-2) and a U/S POWER HIGH/LOW switch on the logic board (base back-cover) (Fig 4-3). This switch selects the range of ultrasonic power provided by the built-in ultrasonic generator. The high range is for thicker wires of 2-3 mils (51-76 microns); the low range is for thinner wires of 0.7 – 2 mils (18-51 microns).

3.2 TARGETING AND MANIPULATION SYSTEMS

3.2.1 TARGETING SYSTEMS

3.2.1.1 SPOTLIGHT (optional) (Fig 3-1, 3-2). The spotlight is mounted at a slight angle to the vertical so that it can project its target pattern under the tip of the capillary. The tubular spotlight MOUNT is fastened to the left side of the MAIN HEAD (Fig 3-2). The spotlight is made up of the SOURCE, TUBE and CONE.

SOURCE contains the 3-pin socket and lamp. It is plugged into the motherboard 6 Vac circuit. The SOURCE is turned ON or OFF by the LIGHT switch on the left control panel (Fig 4-1).

TUBE contains the RETICLE, the GREEN FILTER and the LENS. The reticle forms an annular target pattern (Fig 6-5) on the bonding surface. The lens can be focused on the device by means of the FOCUSING RING.

CONE holds the tube and fastens the spotlight to the spotlight mount by means of a slotted clamp (Fig 6-5). Centering screws in the cone enable the operator to center the spot onto the capillary target.

3.2.1.2 AREA LIGHT (Fig 3-1) illuminates the work area. It is fastened to the front of the main head frame by means of a flexible gooseneck. The area light is controlled by the same LIGHT switch as the spotlight. Rotating the switch knob controls the intensity of the area light.

3.2.1.3 STEREO ZOOM MICROSCOPE (Fig 3-1, 3-2) has both common focusing and individual focusing of the left ocular. The microscope can be removed from its holder bracket by releasing two locking levers. The microscope focusing mechanism forms part of the microscope holder arm that is clamped by a pin to the tubular microscope SUPPORT on the right side of the main head. Wide field zoom viewing and inter-ocular spacing adjustment are also incorporated. Two LOCKING LEVERS secure the microscope to its holder bracket.

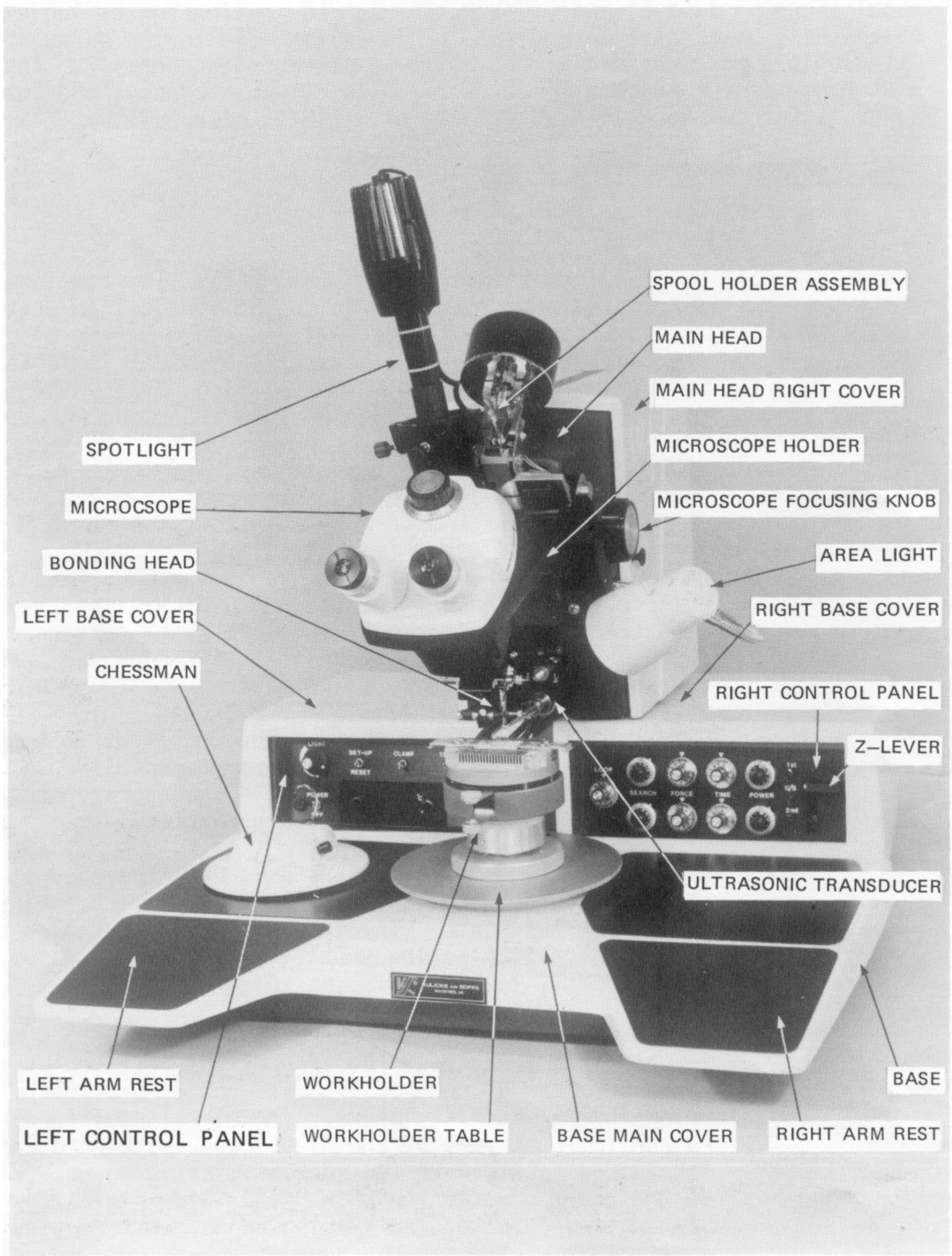


FIGURE 3-1 MODEL 4124 BALL BONDER – MAIN PARTS

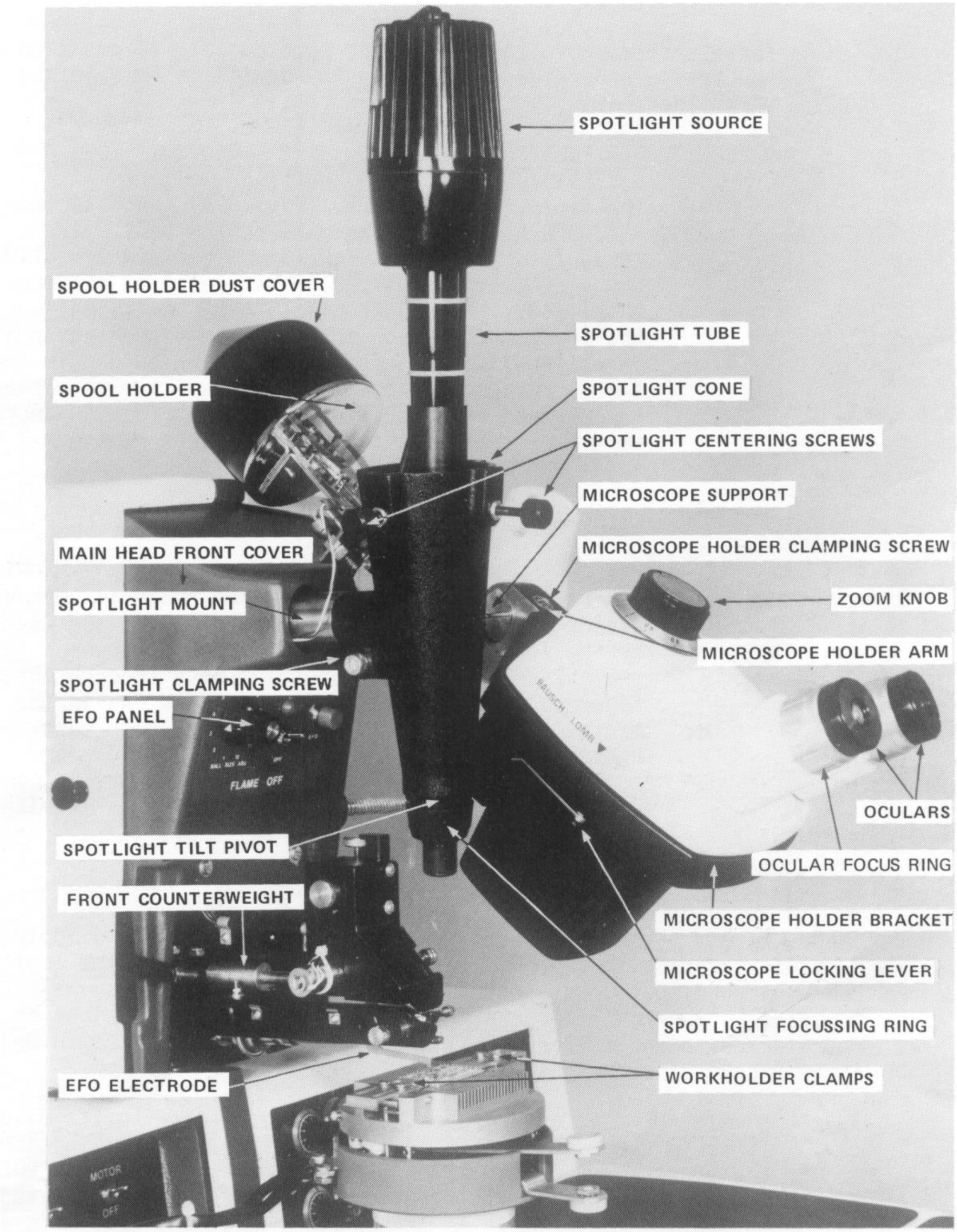


FIGURE 3-2 MODEL 4124 BALL BONDER – FRONT PARTS

3.2.2 MANIPULATION SYSTEMS

These systems move the workholder horizontally to position the device under the capillary. The device is held in the workholder having a circular base.

3.2.2.1 MANIPULATOR ASSEMBLY

The manipulator assembly (Fig 3-3) supports the WORKHOLDER TABLE on the MANIPULATOR BODY. The manipulator body is a four-sided plate that glides on three bearing-ball raceways (pads) in the base (Fig 3-4). For rough positioning at 1:1 motion, the operator can push the workholder by hand in all directions. The manipulator body is guided in the X and Y directions by guide rods that pass between spring-loaded pairs of rollers. The four guide rods form a cross extending from the edges of the X-Y FRAME under the manipulator body (Fig 3-5).

3.2.2.2 CHESSMAN

The chessman handle (Fig 3-6) at the rear of the left arm rest is the fine manipulation control. Manual motion at the chessman is reduced 6:1 at the device by the lever effect of the CHESSMAN ROD, which links the chessman to the manipulator body through three spherical bearings: one in the base, one in the manipulator body, and one in the chessman case. The chessman also contains the CHESSMAN SWITCH for controlling the semi-automatic chessman cycle, and the STITCH SWITCH for making stitch bonds in either CHESSMAN or MANUAL Z mode (Fig 7-3).

3.3 BONDING HEAD PLACEMENT AND FORCE SYSTEMS

These systems place the capillary tip at preset heights and apply mechanical forces in response to electronic signals from the logic board, according to the phases of the bonding cycles (Fig 3-7, 7-1). Manual Z LOOP height is operator-dependent; stitch LOOP height is operator-dependent in the manual Z mode, while in the chessman mode it is preset electronically.

3.3.1 BONDING HEAD is a horizontal lever (Fig 3-8) with its pivot fixed in the main head frame. A V-prism/U-bolt combination in the forward arm of the lever clamps the ultrasonic TRANSDUCER. The transducer receives electrical energy from the ultrasonic generator, converts it to mechanical energy and transmits it to the capillary. The capillary is clamped vertically in a tool

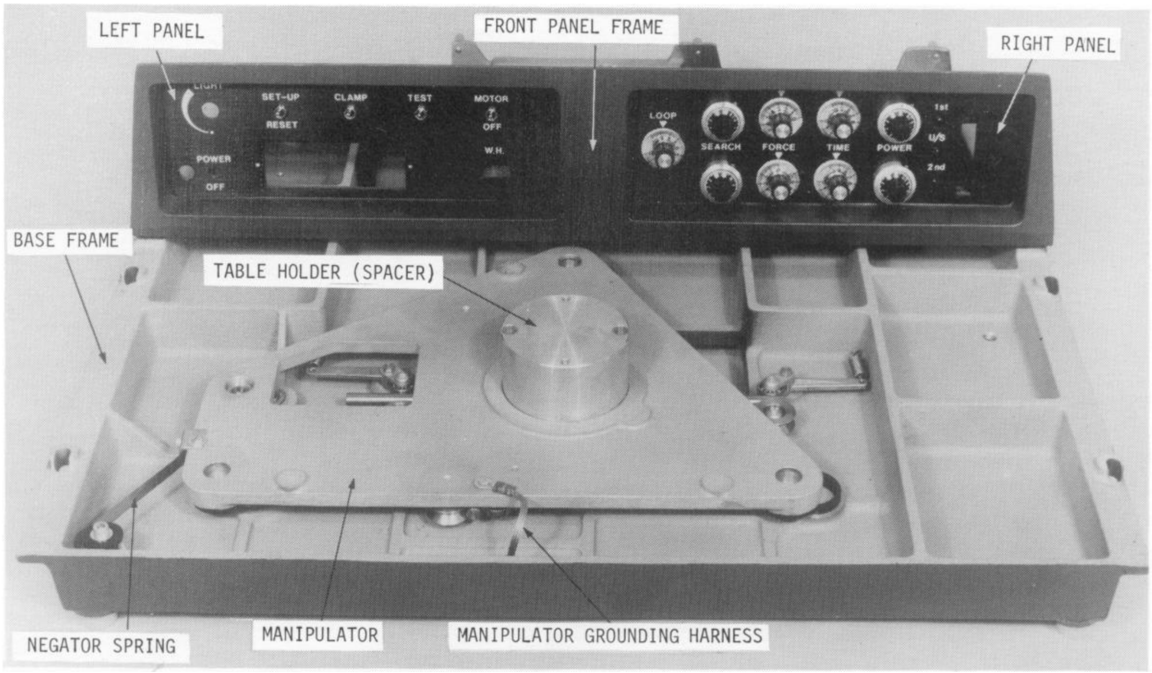


FIG. 3-3 MANIPULATOR ASSEMBLY AND WORKHOLDER TABLE SUSPENSION

FIG 3-4 BASE - MANIPULATOR COUNTERPARTS

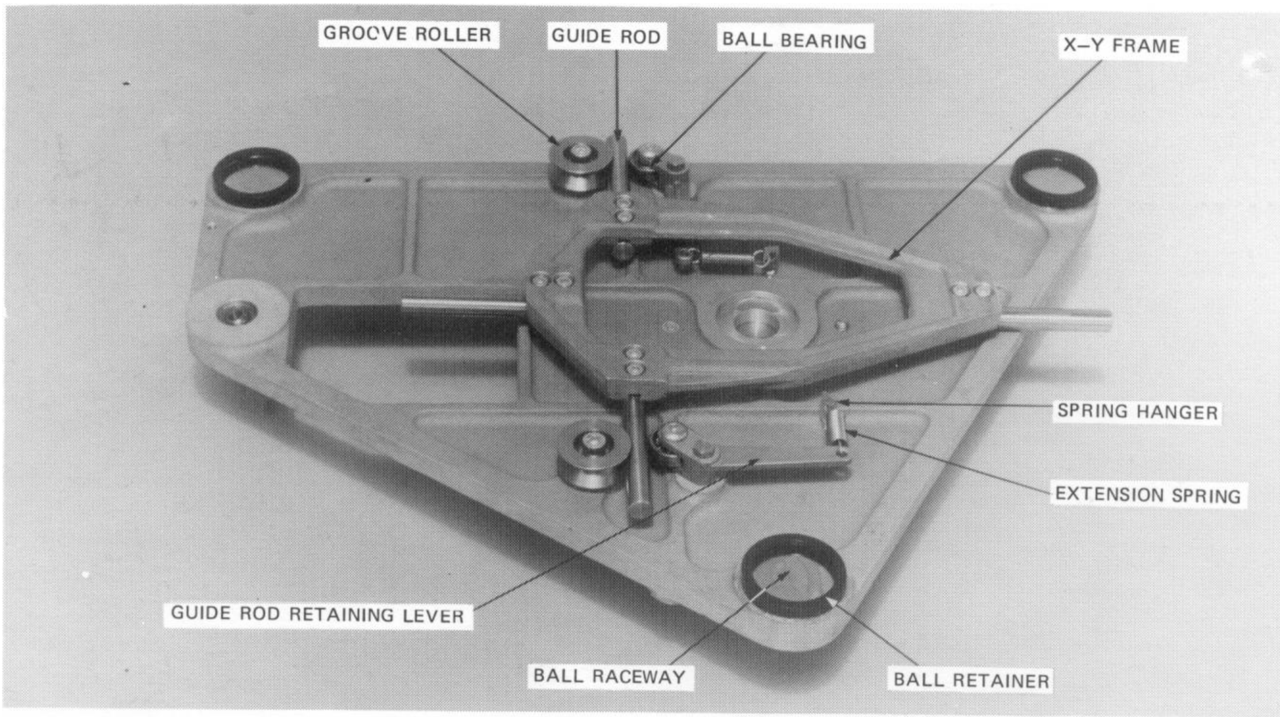


FIG. 3-5 MANIPULATOR UNDERSIDE AND X-Y FRAME

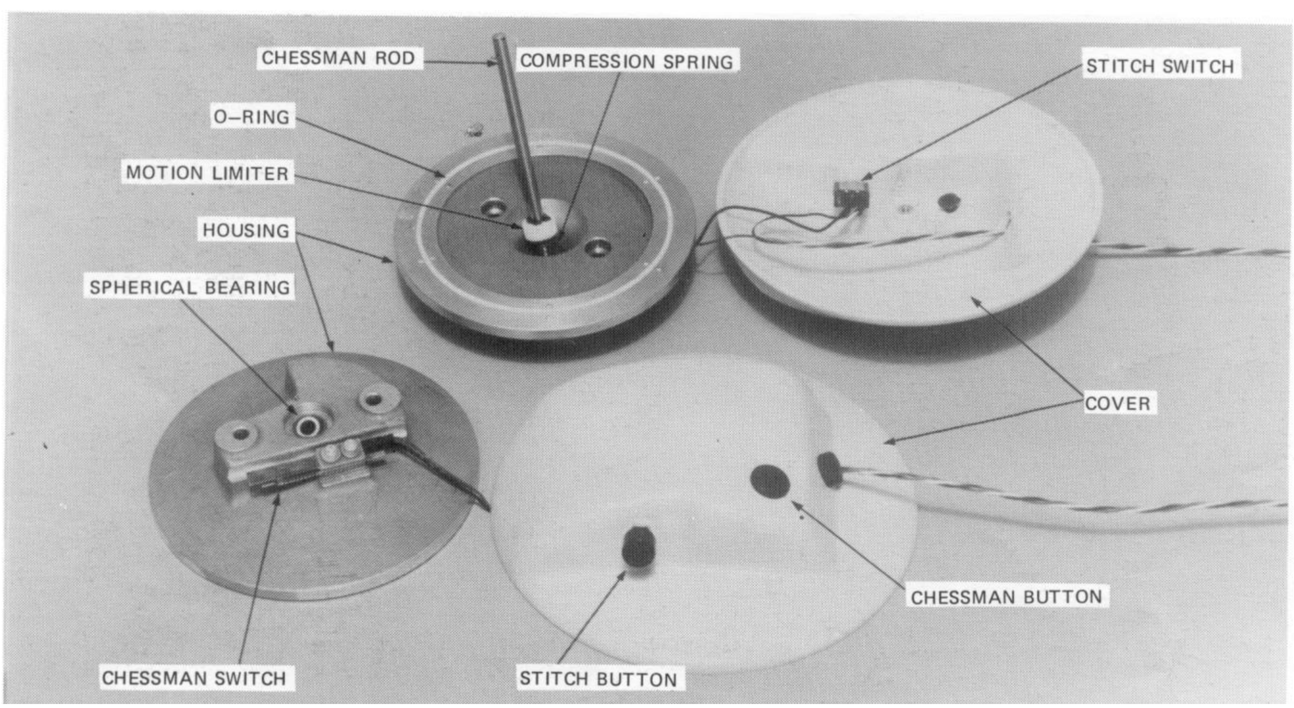


FIG. 3-6 CHESSMAN ASSEMBLY

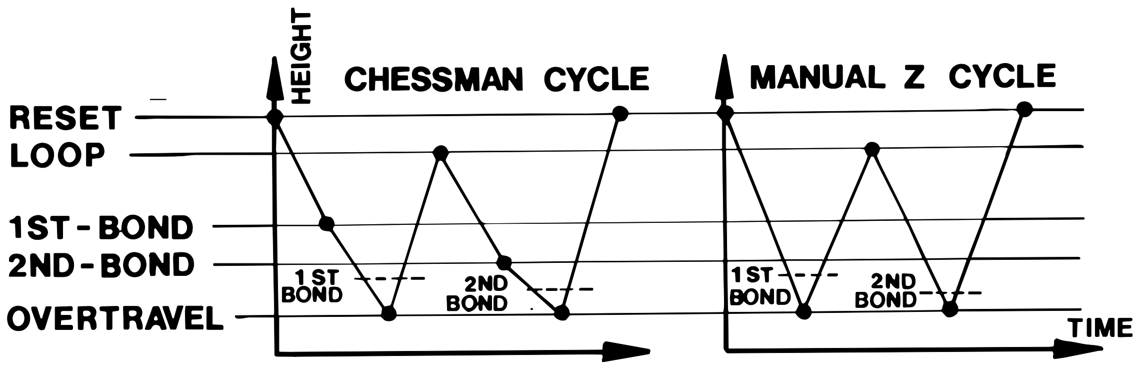
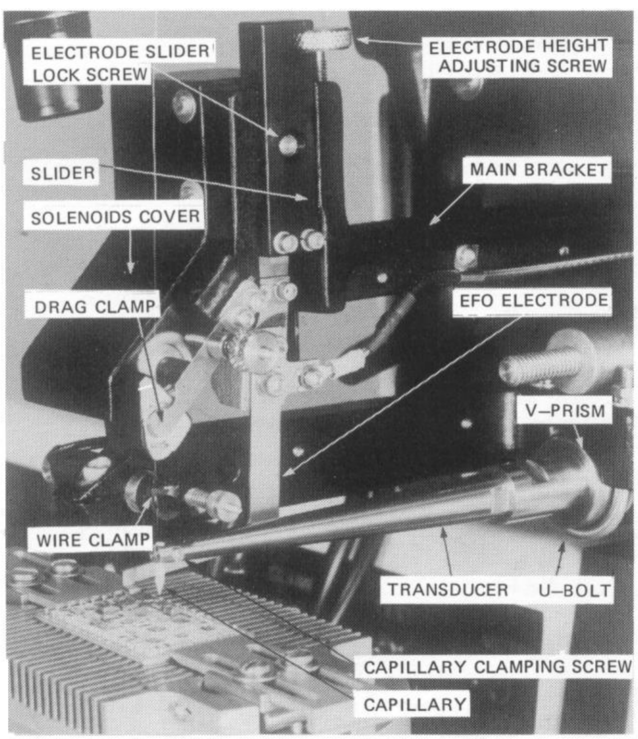
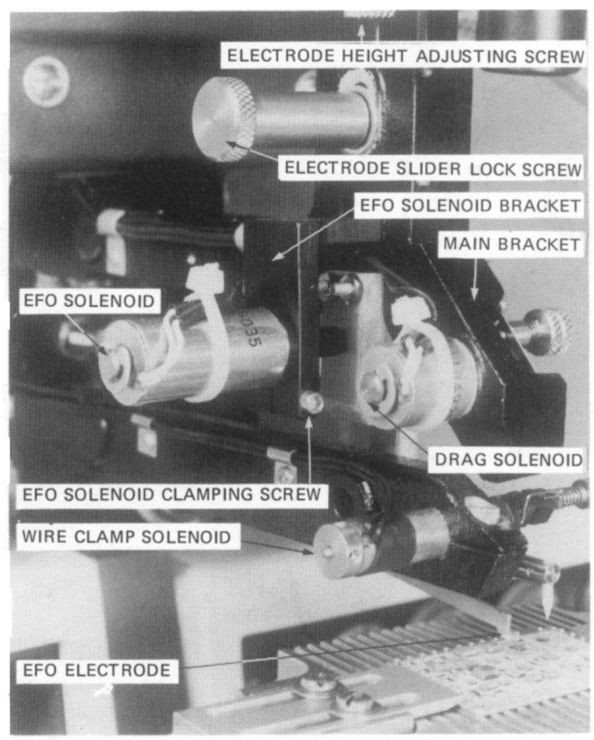


FIG. 3-7 BONDING HEAD PLACEMENTS



WITH SOLENOIDS COVER



SOLENOIDS COVER REMOVED

FIG. 3-8 BONDING HEAD - FRONT END

hole at the tip of the transducer (Fig 3-8). Vertical motion of the capillary is achieved by tilting the bonding head on its pivot. The following parts affect bonding head static balance and dynamic motion:

3.3.1.1 COUNTERWEIGHTS (Fig 3-9) are brass cylinders threaded onto horizontal rods on the bonding head. The FRONT COUNTERWEIGHT is mounted right above the transducer stem. The REAR COUNTERWEIGHT is mounted on the AIR DASHPOT CONNECTING ROD.

3.3.1.2 AIR DASHPOT (Fig 3-9) is an adjustable pneumatic shock absorber that damps the motion of the bonding head. The cylinder is mounted on the main head frame. The piston is connected by ball joint to the AIR DASHPOT CONNECTING ROD.

3.3.2 FORCE ACTUATOR (Fig 3-10) is an electrical moving coil and core mounted with their axis vertical between the poles of a permanent magnet. When the coil is energized, it rises, rushing against the HEEL BALL of the bonding head and lowering the capillary at the front end.

The actuator had 4 force levels: Constant force, Tracking force, 1st Bond force and 2nd Bond force – all applied at the appropriate timing in the bonding cycle (Fig 7-1). The 1st Bond (F1) and 2nd Bond (F2) forces are applied while the capillary is resting on the bond. They are selected by setting the FORCE dials (Fig 4-2).

Tracking force (F3) and Constant force (F4) are set at the factory. The Tracking force overcomes the air dashpot incidental breaking action during descent of the bonding head to SEARCH position and keeps the LEVELING SCREW in contact with the CONTACT PIN (Fig 3-9).

The Constant force continuously keeps the actuator coil in contact with the heel ball. This force is weak enough to be overcome by the LINK RETURN SPRING (Fig 3-10). When POWER switch is OFF, the actuator coil drops away from the heel ball. When power is switched ON, you should hear a click as the actuator coil strikes the heel ball. During normal operation this impact does not occur, since the actuator coil and the heel ball are always in contact.

3.3.3 HEIGHT CONTROL LINK (Fig 3-10) is a vertical lever pivoted independently at its lower end on the BONDING HEAD PIVOT and held back against the HEIGHT CONTROL CAM by the LINK RETURN SPRING. After each bond the actuator force is switched to Constant, allowing

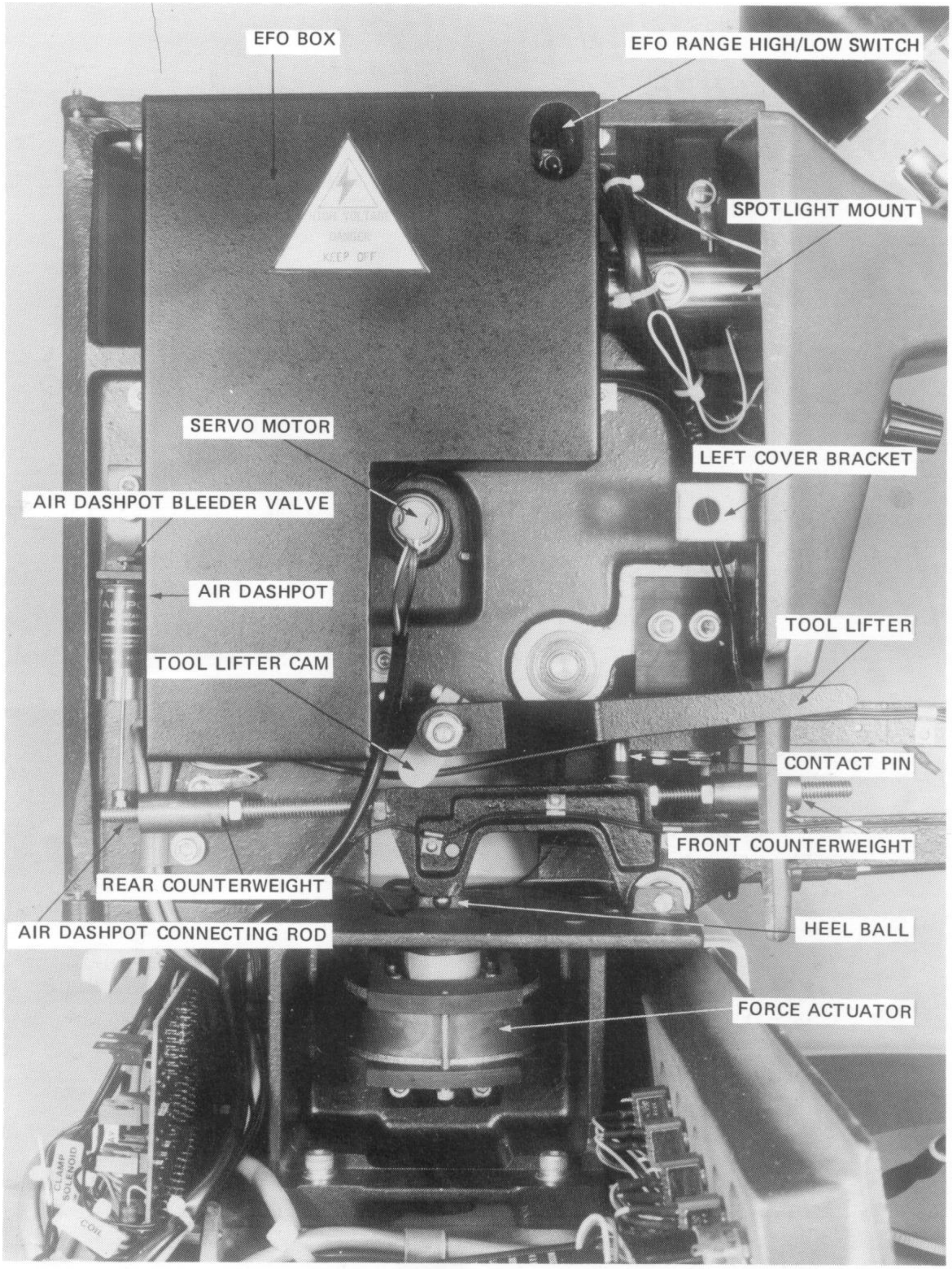


FIG. 3-9 MAIN HEAD - INNER LEFT SIDE

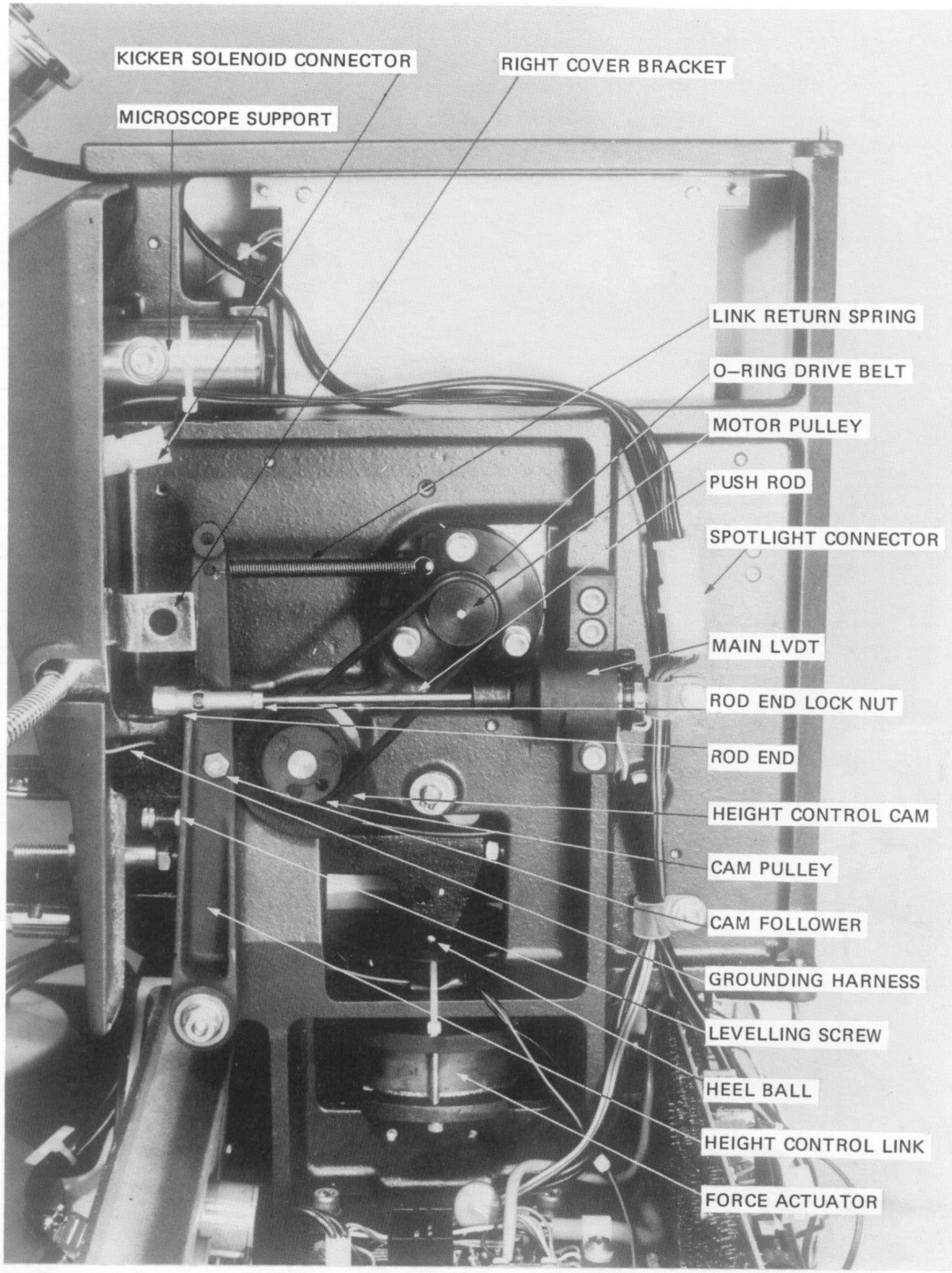


FIG. 3-10 MAIN HEAD - INNER RIGHT SIDE

the link return spring to pull back the height control link as controlled by the height control cam. The LEVELING SCREW on the height control link engages the CONTACT PIN on top of the rear arm of the bonding head and tilts back the bonding head, raising the capillary at the front end.

3.3.3.1 CONTACT PIN MECHANISM (Fig 3-9) maintains electrical contact between the bonding head and the height control link until the descending capillary is stopped by the bonding surface. The height control cam (Fig 3-9) continues to revolve to OVERTRAVEL position, tilting the height control link forward independent of the bonding head.

When the 1st bond is complete, the logic board reduces actuator force to Constant (Fig 7-1) and reverses the SERVO MOTOR. This permits the link return spring to tilt back the height control link and bring the leveling screw back into contact with the contact pin. Restoration of the contact circuit following the 2nd bond triggers in turn the release of the CLAM SOLENOID to secure proper tail and ball size.

3.3.3.2 MAIN LVDT (linear variable differential transformer) (Fig 3-10) feeds back position signals from the height control link to the logic board. The logic board uses these signals to synchronize the bonding cycle and to modulate the bonding speed accordingly.

The main LVDT consists of 3 horizontal cylindrical winding and moving core. The output voltage of the LVDT is proportional to the displacement of the core within the windings. The core of the main LVDT is linked by a PUSH ROD and a ball joint at the ROD END to the upper end of the height control link. Therefore, the LVDT output voltage follows the phases of the bonding cycle.

3.3.4 SERVO MOTOR (Fig 3-10), on signal from the logic board, drives the height control cam through a reduction gear and a belt-drive mechanism. The height control cam engages the cam follower on the height control link, thus regulating its tilt forward or backward. A built-in TACHOMETER on the servo motor feeds back motor speed signals to the logic board, which uses these signals to modulate the bonding head speed.

3.3.5 TOOL LIFTER (Fig 3-9) enables the operator to raise the front end of the bonding head manually for threading wire, replacing capillary, or protecting the capillary when not in use. Raising the handle causes its cam to engage and lower the rear part of the bonding head, causing the capillary to rise.

3.3.6 MANUAL Z SYSTEM (optional) Fig 3-11, 3-15) is used for all applications where slow manual control of the bonding head is required, where great bonding height differences are encountered, and when high placement precision is required.

The manual Z system has two functions:

1. To switch Bonder logic from chessman mode to manual Z mode, or the reverse, by means of a photocell (optocoupler).
2. To generate and feed back electrical position signals to the logic board, to lower and raise the bonding head and synchronize the bonding cycle accordingly.

After 2^{nd} bond, the bonding head rises automatically to RESET position.

3.3.6.1 Z-LEVER in the right control panel (Fig 4-2) pivots on a bearing fastened to the Bonder base. When the Z-LEVER is lowered, it transmits motion through a vertical LEVER, a ball joint and a PUSH ROD, driving the core through the Z-LVDT.

When the Z-lever is released, the Z RETURN SPRING raises the Z-lever to its original position and retracts the core from the Z-LVDT winding. Two screws limit downward and upward travels of the lever.

3.3.6.2 Z-PHOTOCELL (OPTOCOUPLER) SYSTEM is activated when the PHOTOCELL FLAG on the Z-lever is lowered, permitting light to fall on the photocell. The resulting signal to the logic board switches the Bonder logic to manual Z mode, in which the bonding cycle is controlled by motion of the Z-lever. Raising the Z-lever with its FLAG re-masks the photocell, and after the 2^{nd} bond automatically returns logic to chessman mode. An electronic time delay then stabilizes the system, and fully controlled motion assures precise tail and ball formation.

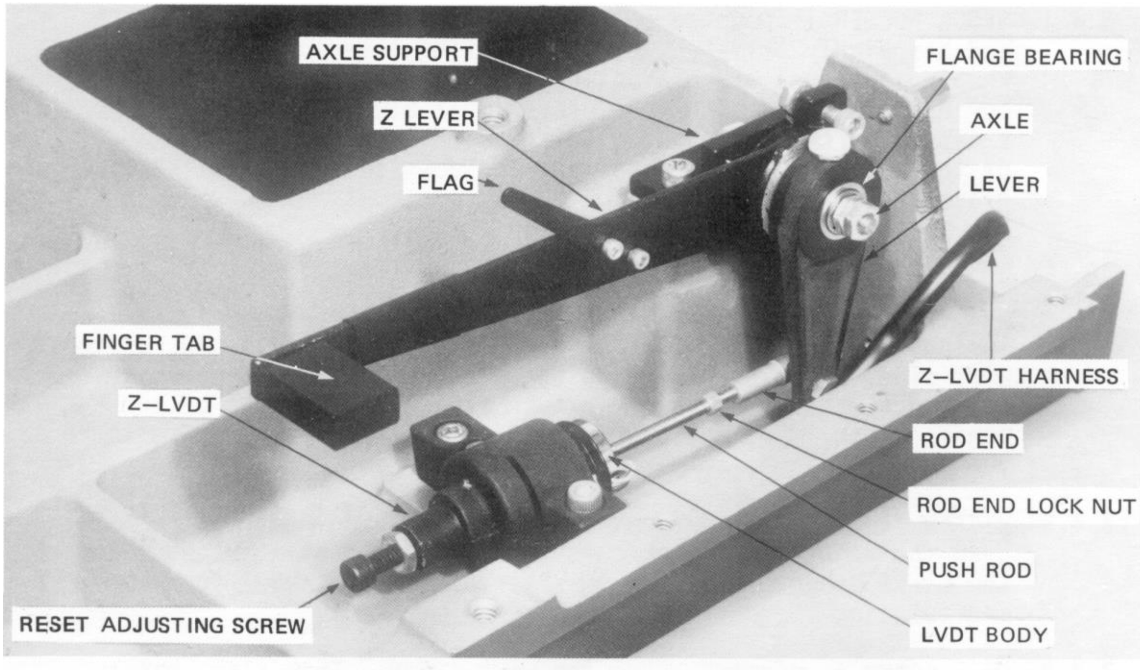


FIG. 3-11 MANUAL Z ASSEMBLY

3.3.6.3 Z-LVDT (linear variable differential transformer) in the right compartment of the base converts linear motion of the core into electrical signals. The principal elements of the Z-LVDT are the stationary windings and the moving core. Output voltage is proportional to the displacement of the core. On the logic board, the Z-LVDT output is interpreted as a variable reference signal for raising and lowering the capillary and for synchronizing the cycle.

3.4 WIRE FEED SYSTEM

The wire feed system provides a wire length just sufficient for each successive phase of the bonding cycle, and tears off the wire from the last bond of the cycle, leaving off the correct length of tail hanging from the capillary for making a new ball.

The main components of the bonging wire feed system are the SPOOL HOLDER, the FIXED TENSIONER, the KICKER, the DRAG CLAMP and the WIRE CLAMP (Fig 3-8, 3-12, 6-6).

3.4.1 SPOOL HOLDER is mounted on a bracket on the microscope support and has highly polished, closely-fitting interior surfaces for keeping out dust and preventing spool or wire from binding during wire feed. The spool cover must always be in place, except when changing a spool. The wire is fed from the top of the spool, over the spool cap and down through a polished glass tube.

3.4.2 FIXED TENSIONER is mounted below the spool holder. It clamps the wire between a glass upper plate and a metal grounding plate, by means of a white plastic screw at the tip of a sensitive leaf spring. The rounded edges of the glass plate face downwards the wire side. Turning the clamping screw regulates the pressure exerted on the wire, which in turn affects the height of the bonding loop. The metal grounding pate connects the wire to the machine frame, completing the EFO circuit.

3.4.3 KICKER is a nearly vertical link (tongue) hanging from the main head top front. The kicker is thrown forward by a solenoid at the first bond to pull enough slack out of the spool for manipulating the device.

3.4.4 DRAG CLAMP is mounted above the wire clamp. This clamp has two functions:

1. To seat the ball against the capillary tip before 1st bond, preventing any tail residue.
2. To strain-harden the wire just above the ball so that the higher loops come out stable enough. This is particularly important for high loops as encountered in hybrid type bondings, where loop short-circuiting at surface corners and edges might result due to height differences.

The drag clamp has two jaws, one fixed and one spring-loaded, adjustable by means of a force adjustment nut at the right. Two wire guides lead the wire right across the jaws (Fig 3-8)

3.4.5 WIRE CLAMP is mounted straight above the capillary. It has two horizontal jaws, one of which is mobile and spring-loaded. The clamping force can be adjusted by means of a nut at the right, holding the compression spring and locked by another nut. The clamp solenoid, on signal from the logic circuit or the CLAMP switch, opens the clamp against this spring pressure (Fig 6-4).

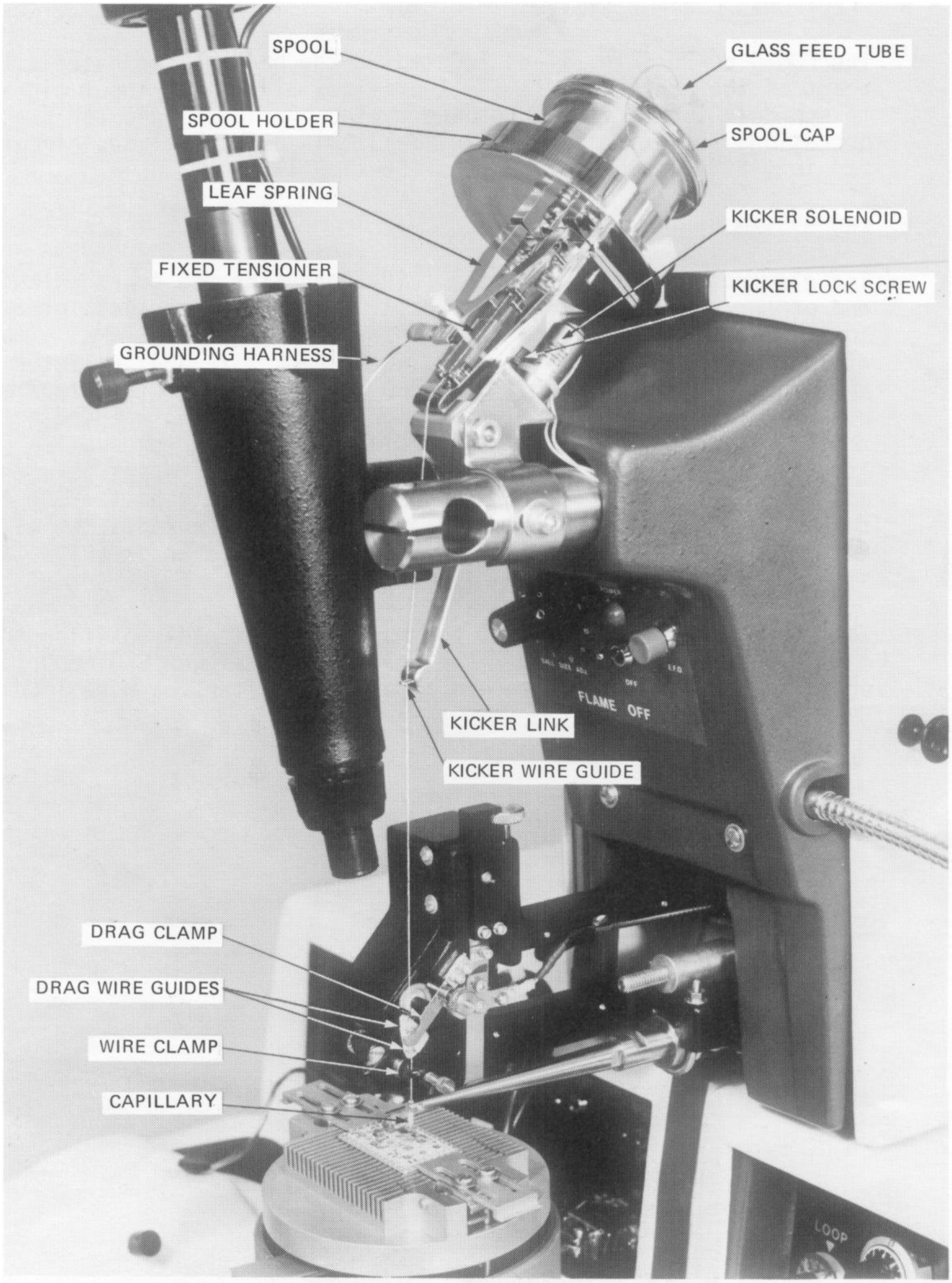


FIG. 3-12 WIRE FEED SYSTEM

3.5 ELECTRONIC CONTROL SYSTEM

The LOGIC BOARD (Fig 11-8) located at the back of the base is the heart of the control system. It utilizes electrical input signals to schedule events in the bonding cycle. Besides logic for sequencing operation, (see Time Study, Fig 7-1) this board includes circuitry for initiating machine functions (Section 11).

3.6 EFO SYSTEM

The ELECTRONIC FLAME-OFF system (EFO) generates the spark that melts the end of the wire tail, forming a ball. The system consists of a power supply circuit board in the main head (Fig 3-13, 11-9), a movable electrode actuated by a solenoid, and a BALL SIZE ADJ. selector on the EFO panel (Fig 3-2, 4-4). The EFO circuit charges the electrode to a high dc voltage (Section 11). A signal from the logic board activates the EFO solenoid, which tilts the electrode toward the capillary (Fig 3-8). As the electrode tip approaches the wire, a spark passes between electrode and wire, melting the end of the wire and forming a ball. The logic then turns off the EFO solenoid, and a return spring retracts the electrode. An additional EFO RANGE HIGH/LOW switch on the EFO circuit (Fig 3-9, 3-13) selects power range per wire diameter.

The electrode can be adjusted for height, horizontal position and overtravel. A red EFO pushbutton enables the operator to trigger EFO manually if normal operation has ailed to produce a ball, and after new wire loading.

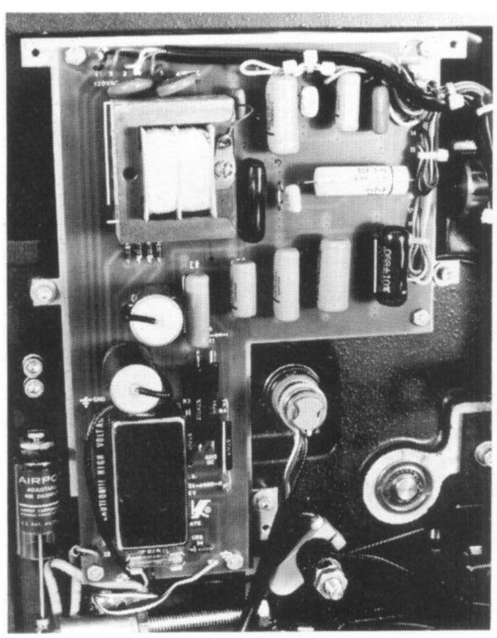


FIG. 3-13 EFO BOX (COVER REMOVED)

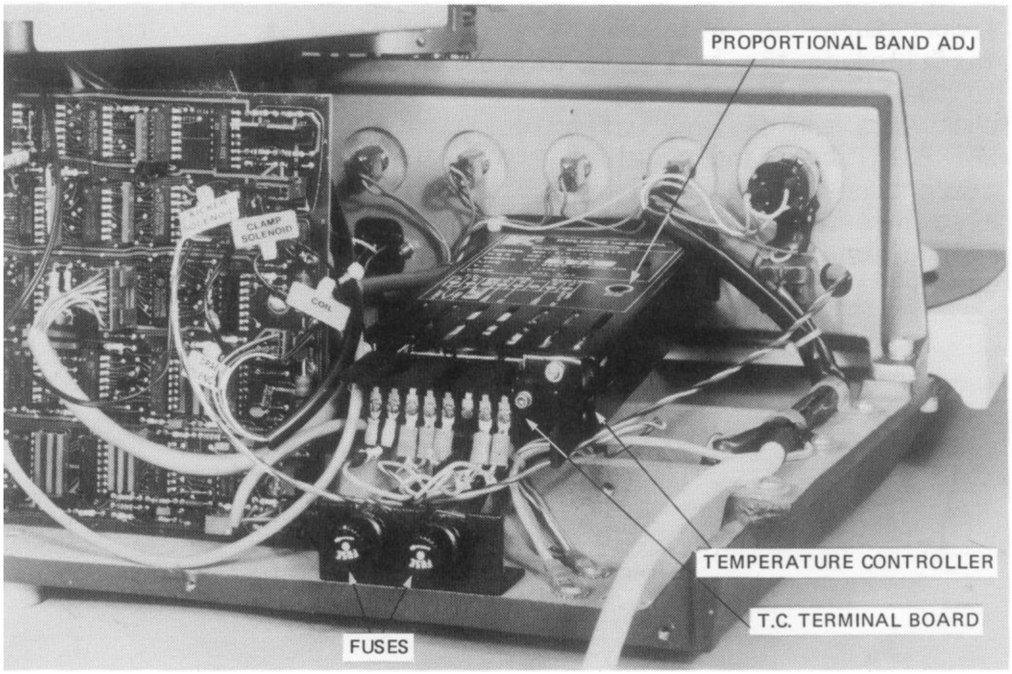


FIG. 3-15 BASE - REAR LEFT COMPARTMENT

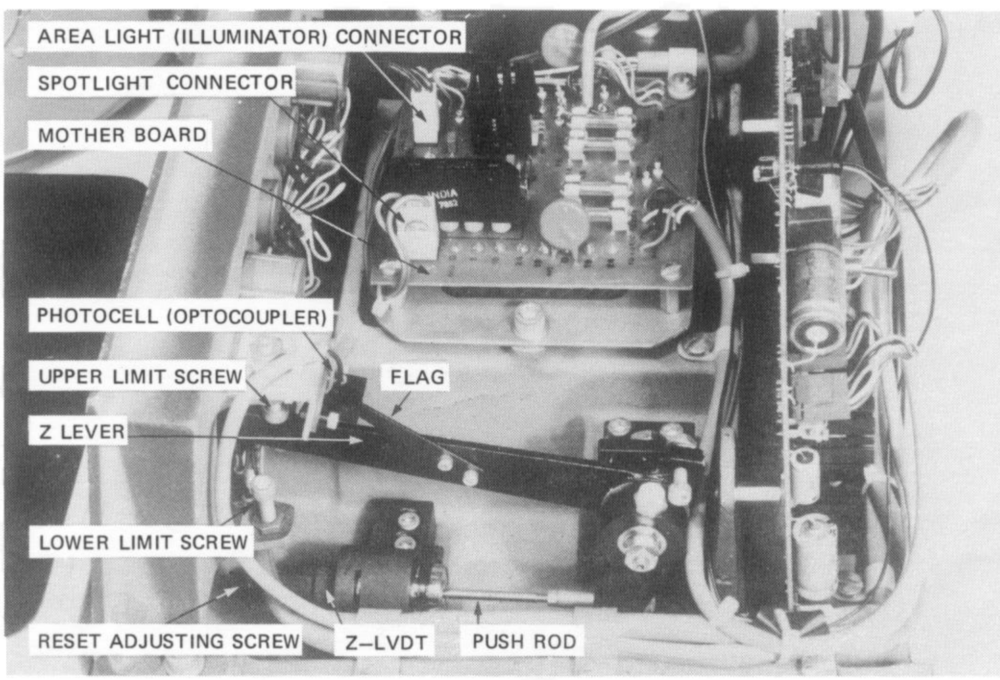


FIG. 3-15 BASE - REAR RIGHT COMPARTMENT

3.7 TEMPERATURE CONTROLLER

Temperature Controller Model KTC-101 Type J is an independent unit installed in the left control panel (Fig 3-14, 4-1) and connected to the workholder through the "W.H." jack in the same panel. The unit sets the desired workholder temperature by means of a SET POINT knob and displays either this limit value or the actual temperature, determined by a DISPLAY SELECT pushbutton. The unit also incorporates zero-offset, cold-junction compensation and proportional-band (heat capacity compensation) circuits and adjustments, as well as OPEN T.C. and LOAD ON (load heating) indicators.

4. CONTROLS AND INDICATORS

Before operating the Bonder, familiarize yourself with all of its controls and indicators.

4.1 LEFT PANELS

4.1.1 LEFT PANEL (Fig 4-1) controls basic machine functions and houses the workholder jack and the temperature controller:

POWER/OFF switch turns main power on and off.

LIGHT/OFF control switches both AREA LIGHT and SPOTLIGHT on and off. Further clockwise rotation increases brightness of area light alone, adjusted for best spotlight visibility.

SET-UP/RESET toggle switch is used when setting bond forces, and for resetting the system for the next bonding cycle:

UP position applies Bond force to the bonding head, according to which LED lights in the right panel:
When 1^{st} LED lights – 1^{st} Bond force applies
When 2^{nd} LED lights – 2^{nd} bond force applies -
as preset by respective FORCE dials.

MID position permits normal operation

DOWN position (momentary) resets the cycle, bringing the bonding head back to RESET or LOOP position. Bonder is ready for the next operator command, e.g. CHESSMAN BUTTON or Z-LEVER operation.

CLAMP toggle switch opens both wire and drag clamps for wire loading:

UP position causes clamp to open.

DOWN position permits normal operation controlled by logic.

TEST switch (momentary) checks tuning of ultrasonic generator. If well tuned, “U/S” LED on the right panel lights up.

MOTOR/OFF toggle switch turns motor off when making mechanical adjustments on the bonding head:

UP position permits normal operation controlled by logic.

DOWN position turns motor off.

W.H. is the workholder jack, connecting it to the temperature controller.

In addition, the temperature controller on this panel regulates and displays the temperature of the workholder:

DISPLAY SELECT pushbutton displays either the actual workholder temperature or the set-point (preset) temperature.

PRESSED position displays the set-point temperature
RELEASED position displays the actual temperature

SET-POINT knob adjusts the desired temperature, while pressing the DISPLAY SELECT pushbutton, as displayed.

4.1.2 RIGHT PANEL (Fig 4-2) houses bonding-parameter regulation (setting) dials, indicators for “1st” and “2nd” bonding operations, and the Z-lever for manual Z bonding. The bottom row of dials including LOOP, controls the 2nd bond parameters.

4.1.2.1 INDICATORS

“1st” LED refers to the 1st bond, corresponding to the top row of dials.

“2nd” LED refers to the 2nd bond, corresponding to the bottom row of dials including LOOP.

“U/S” indicates that the ultrasonic circuit is tuned, when the left-panel TEST pushbutton is pressed and at bond time.

4.1.2.2 DIALS

LOOP regulates (sets) loop height in chessman mode.

SEARCH regulates the height of the bonding head in SEARCH position. Rotates 10 turns, counted on a small top window.

FORCE regulates downward force exerted by the capillary on the bond.

TIME regulates duration of the ultrasonic bonding pulse.

POWER regulates ultrasonic power level. Rotates 10 turns, counted on a small top window.

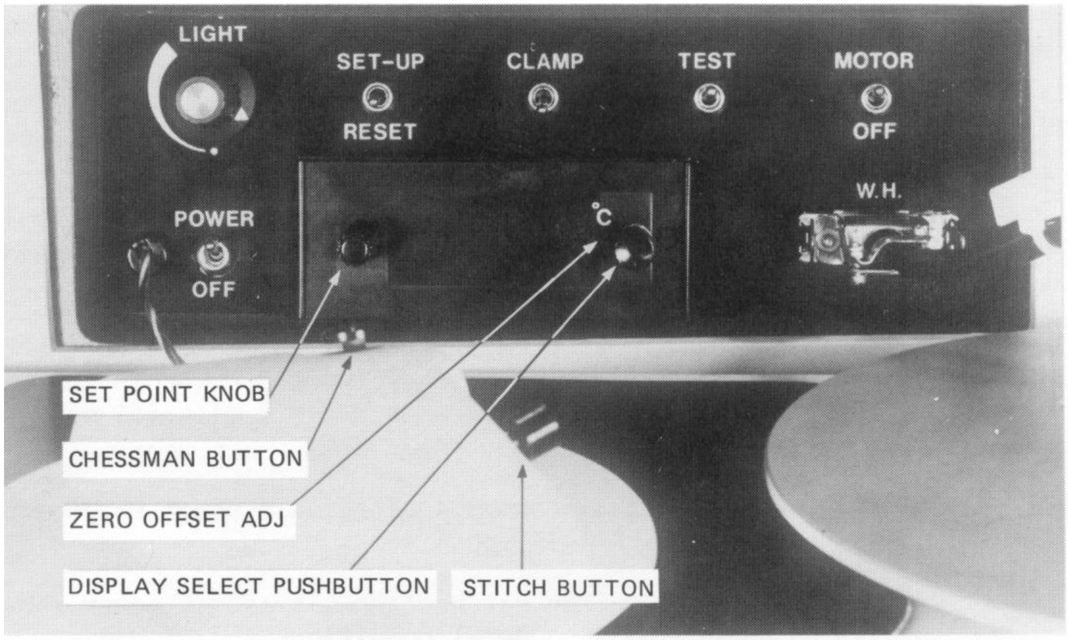


FIG. 4-1 LEFT CONTROL PANEL

FIG. 4-2 RIGHT CONTROL PANEL

4.1.3 EFO PANEL (Fig 4-3) controls EFO functions:

POWER ON/OFF switch turns main power to the EFO circuit on and off.

BALL SIZE ADJ. sets ball dimensions by regulating the flame-off power.

EFO red pushbutton charges the electrode and permits the operator to fire EFO manually by tilting the electrode, either if a ball was not formed in normal (semi-automatic) operation or after loading a new wire.

NOTE: An auxiliary EFO RANGE HIGH/LOW switch located on the EFO board (Fig 3-9, 3-13) matches the EFO power to the wire diameter range group: LOW when under 2 mils (51 microns), and HIGH when over 2 mils.

4.1.4 BASE BACK COVER (Fig 4-4) controls ultrasonic power range and indicates RESET and OVERTRAVEL positions.

U/S POWER HIGH/LOW switch matches the ultrasonic power range to wire diameter and to general conditions.

LED 1 lights up when bonding head is at RESET.

LED 2 lights once when bonding head reaches OVERTRAVEL range.

4.2 MANIPULATOR CONTROLS

4.2.1 CHESSMAN (Fig 3-1) is a white dome-shaped handle in front of the left panel, and houses three controls:

CHESSMAN MECHANISM is connected to the manipulator plate beneath by a rod and a 6:1 linkage with 3 ball-and-socket bearings. Sliding the chessman over the main cover of the base manipulates the device by moving the manipulator plate on which the workholder table rests.

CHESSMAN BUTTON on top of the chessman case triggers semi-automatic bonding and brings the bonding head to SEARCH position.

STITCH BUTTON on the side of the chessman case controls manual stitch bonding operation after the 1st bond in both chessman and manual Z mode.

4.2.2 WORKHOLDER TABLE (Fig 3-1) supports the workholder. It enables the operator to manipulate the workholder horizontally over a 3.75” x 3.75” field in direct 1:1 motion.

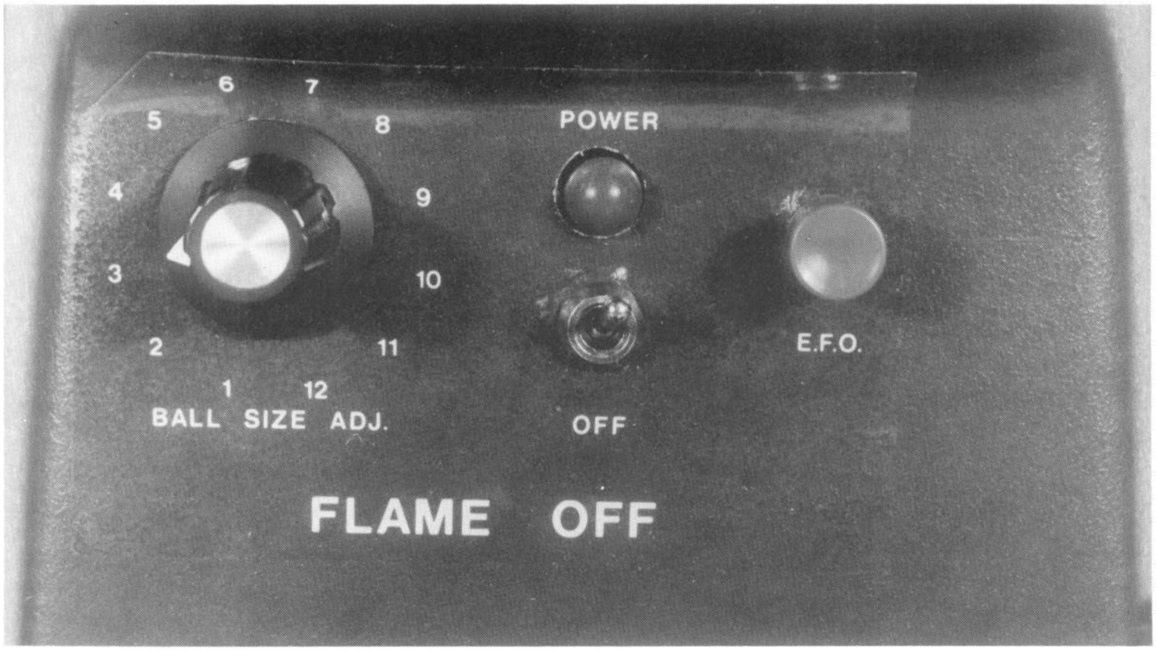


FIG. 4-3 EFO PANEL

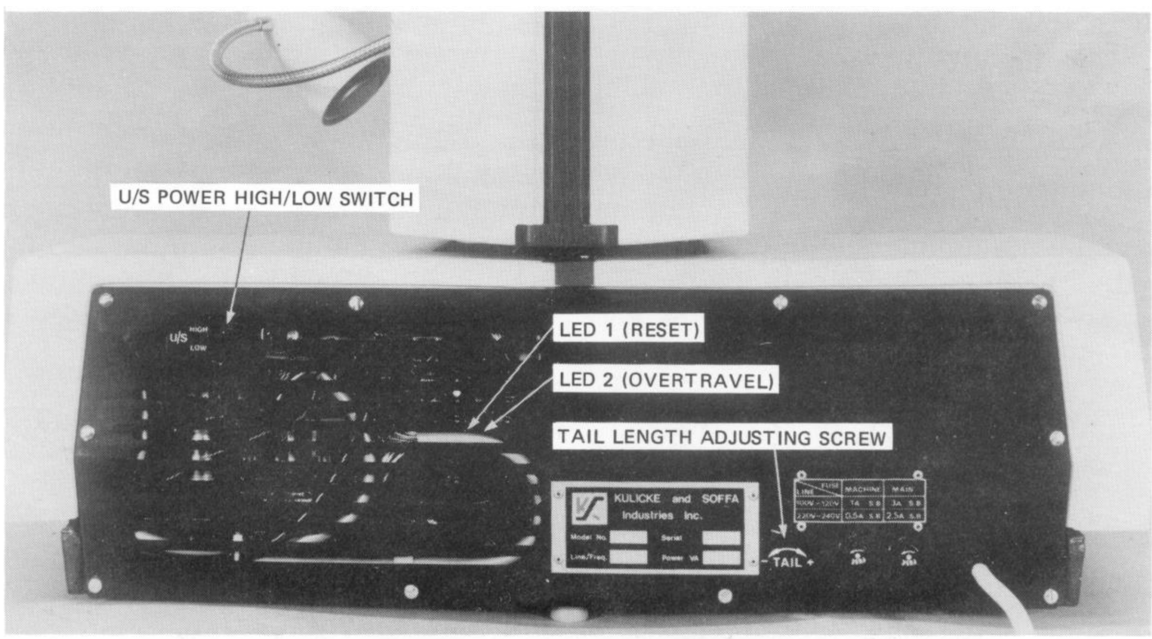


FIG. 4-4 BASE - REAR VIEW

4.2.3 Z-LEVER (optional) (Fig 3-1) projects from a slot near the right edge of the right panel. Pressing down on the Z-lever lowers the capillary onto the device and starts the manual Z cycle. Releasing the Z-lever allows the bonding head to rise. When the Z-lever is released after the 2nd bond it resets the mode circuit back to chessman, whereby the head automatically returns to RESET.

4.3 STEREO ZOOM MICROSCOPE (Fig 3-2) is top mounted and enables the operator to aim the bonding capillary at the target area with the aid of the spotlight (optional). It is also useful for inspection and quality control of the bonded part.

4.3.1 CLAMPING SCREW locks the microscope frame against the microscope support pin, holding the desired angle to the vertical and its left-right position.

4.3.2 FOCUSING KNOB focuses both oculars together.

4.3.3 OCULAR FOCUS RING focuses left ocular independently.

4.3.4 ZOOM KNOB changes magnification for detail or wide field viewing.

4.3.5 In addition, the spacing between the oculars can be adjusted by shifting them by hand toward or away from each other.

4.4 SPOTLIGHT (optional) (Figs 3-2, 6-5) projects an annular spot of light on the work surface, marking the place where the bonding capillary is to descend.

4.4.1 CLAMPING SCREW on the spotlight mount allows rough adjustment of spot location by changing forward/back position and side tilt of the spotlight barrel.

4.4.2 CENTERING SCREWS are for fine adjustment of spot location.

4.4.3 FOCUSING RING focuses the spot on the work surface.

5. UNPACKING AND ASSEMBLING

5.1 UNPACKING

5.1.1 Remove packing list from the pocket attached to the outside of the shipping carton.

5.1.2 Cut the plastic bands that bind the carton.

5.1.3 Open carton flaps. Lift out the envelope of documents from the inner lid.

5.1.4 Lift out the two sponge slabs that separate the inner lid from the carton (Figure 5-1).

5.1.5 Using a screwdriver or any flat long tool, insert tool into a side gap of the inner lid, press aside as necessary and lift out the lid.

5.1.6 Remove bubble sheet that covers the machine.

5.1.7 Lift machine-box out of its “cage” in front of the machine, open it and take out the small parts box or boxes.

5.1.8 Grasp the upper wood stick of the machine sleeve (Fig 5-1) and lift the sleeve out of the carton. As the sleeve fits tightly inside the carton, hold carton down with your other hand.

5.1.9 Remove rubber band that ties the head covers (doors) together and open the covers. Lift Bonder with attached shipping board out of the carton onto a cart. Two workers are required for this purpose: one grasping the two base arm-rests, the other holding the main head top handle-bracket with the doors open while holding down the carton with the other hand.

5.1.10 Strip off the bubble sheet from the Bonder base (Fig 5-2).

5.1.11 Using a flat wrench 9/16”, remove the shipping screws, spacers and board from the Bonder (Fig 5-2).

5.1.12 Bring the Bonder to the place where it is to be installed. Make sure that the Bonder rests on a stable platform at a still, draftless location. No fixing is required.

5.1.13 Unwrap the area light by cutting the twine at the ends of the woven sponge sleeve and slipping the sleeve off (Fig 5-1).

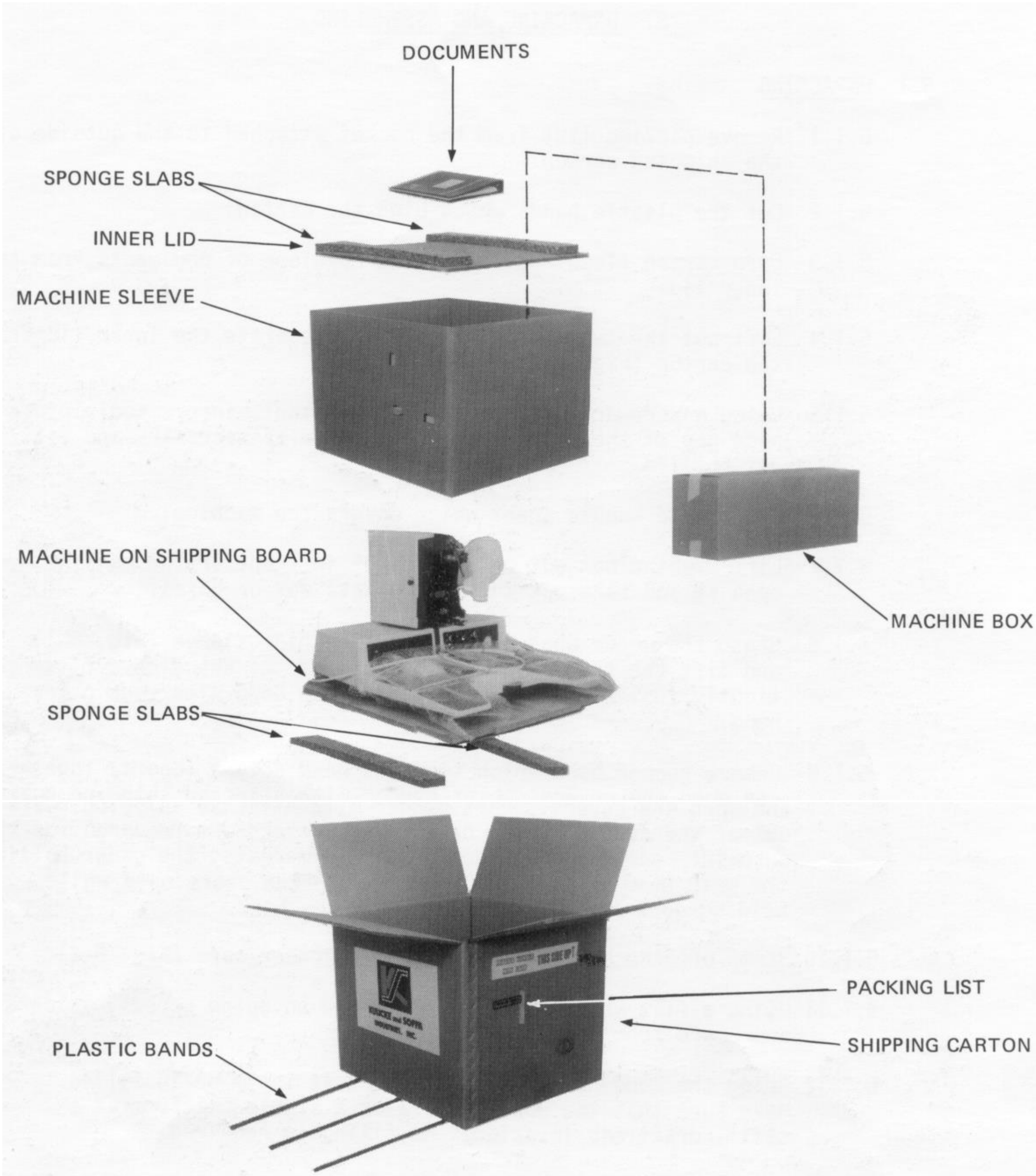


FIG. 5-1 BONDER PACKAGING - EXPLODED VIEW

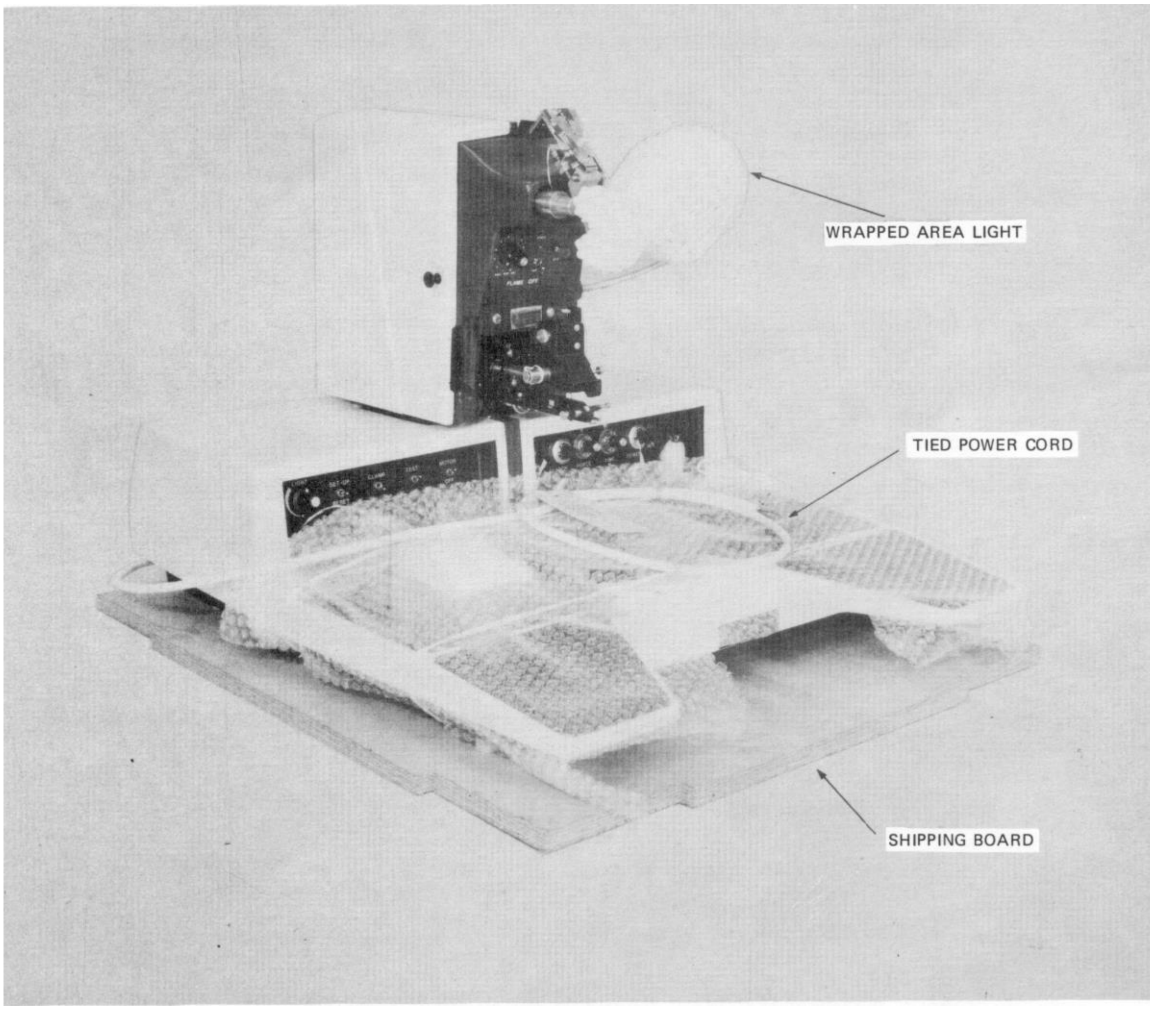


FIG. 5-2 BONDER MOUNTED ON SHIPPING BOARD

5.1.14 RECEIVING INSPECTION: Open the small-parts box or boxes and check all items against the packing slip. If any part is missing, immediately notify the supplier by telephone, cable or telex. If any item is damaged, immediately notify supplier and shipper.

5.1.15 Remove the sponge packing from beneath the rear counterweight rod of the bonding head (Fig 5-3).

5.1.16 Open the right head cover and remove the rubber band that ties the height control link to the main LVDT holder (Fig 5-4).

5.1.17 Remove the sponge packing from beneath the heel ball of the bonding head and the moving coil of the force actuator (Fig 5-4).

5.1.18 Remove the sponge packing from beneath the cam pulley and the height control link.

5.1.19 Remove sponge packing from the slot under the Z-lever (Fig 5-5).

5.1.20 Remove small plastic pieces from beneath the jaws of the wire and drag clamps (Fig 5-6).

5.1.21 Free the manipulator assembly as follows:

5.1.21.1 Using Allen wrench #24, remove two shipping screws that fasten the workholder table to the manipulator. Carefully lift off the table.

5.1.21.2 Remove the two rubber spacers that were compressed between the table and the main cover, and the rubber ring surrounding the table holder (Fig 5-7A).

5.1.21.3 Remove the three rubber wedges from beneath the manipulator body and the main cover (Fig 5-7B).

5.1.21.4 Take the small plastic envelope containing the two original table screws out of the small-parts box. Carefully reinstall the table and, using Allen wrench #24, fasten table to table holder with these screws.

5.2 ASSEMBLING

5.2.1 POWER PLUG

Uncoil the power cord. If no plug is connected, install a 3-pin plug that fits your mains. Note in particular the ground connection and remove “GROUND” label. Also, check on Bonder nameplate for the correct voltage and frequency of the machine received.

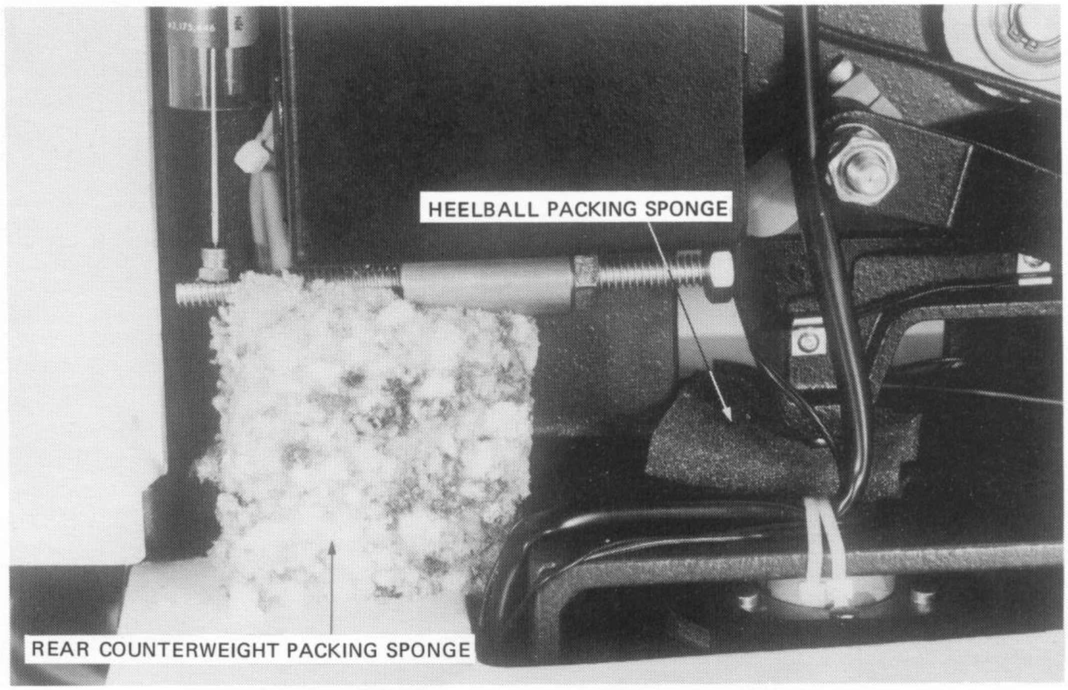


FIG. 5-3 MAIN HEAD PACKAGING - INNER LEFT SIDE

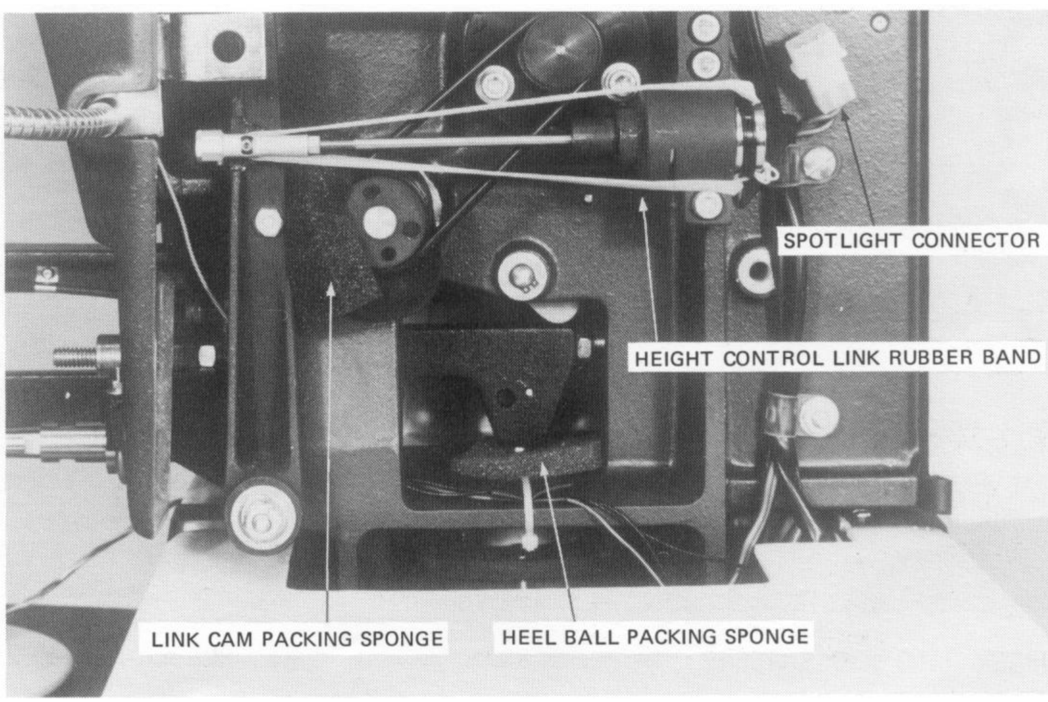


FIG. 5-4 MAIN HEAD PACKAGING - INNER RIGHT SIDE

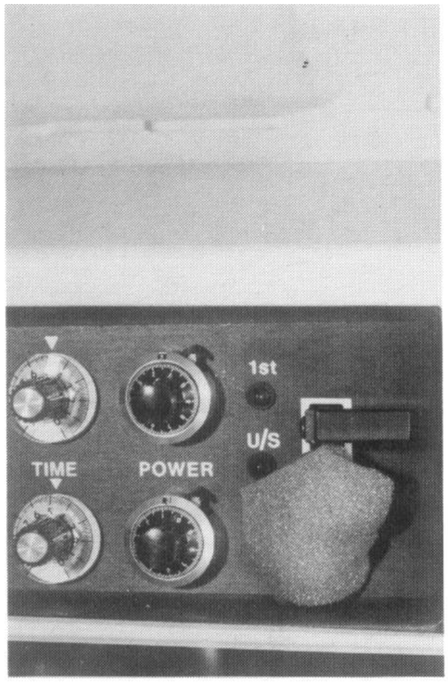


FIG. 5-5 Z-LEVER PACKAGING

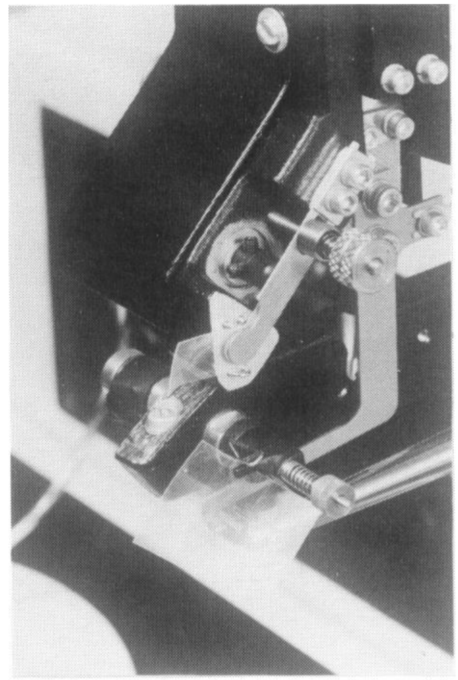
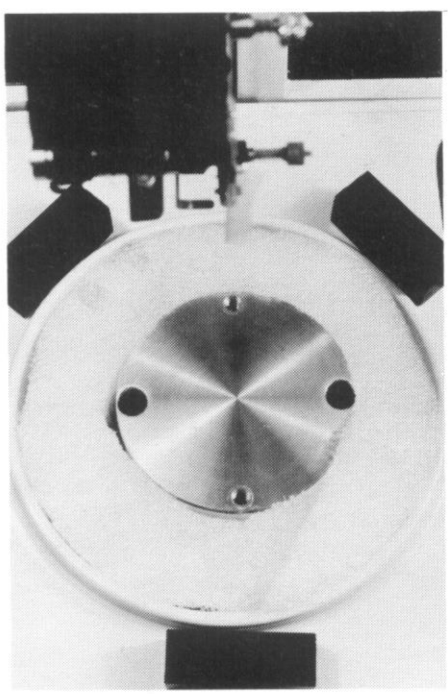
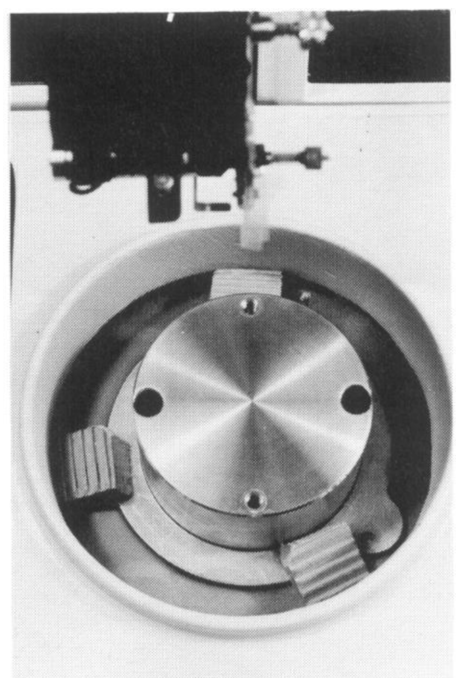


FIG. 5-6 CLAMPS PADDING



A. RUBBER RING SPACERS



B. RUBBER WEDGES

5.2.2 WORKHOLDER

Place workholder on the table and plug its cable into the “W.H.” jack on the left control panel.

5.2.3 MICROSCOPE HOLDER / MICROSCOPE (optional)

5.2.3.1 Take microscope holder out of the small parts box, unwrap and install on the microscope support (Fig 3-10, 3-12)

5.2.3.2 Using Allen wrench #25, tighten microscope support screw.

5.2.3.3 If microscope is supplied, mount it on the holder bracket from top and fix by the two locking levers (Fig 3-2).

5.2.4 SPOTLIGHT

5.2.4.1 Using Allen wrench #26, loosen the spotlight mount clamping screw (Fig 3-9). Remove mount from main head.

5.2.4.2 Insert spotlight mount into spotlight clamp and, using Allen wrench #26, tighten the spotlight clamping screw (Fig 3-2) about the correct side-tilt.

5.2.4.3 Insert spotlight cord through the spotlight mount hole in the main head front cover. Insert spotlight mount (with spotlight attached) into the hole and using Allen wrench #26 tighten mount to main head frame.

5.2.4.4 Lead spotlight cord just below microscope support to the spotlight connector at the rear and plug it in. (Fig 3-10).

5.2.5 SPOOL HOLDER AND FIXED TENSIONER

Take the spool holder assembly, leaf spring assembly and tensioner glass plate out of the small parts box, unwrap, clean thoroughly and install on the spool holder support and on the fixed tensioner, respectively (Section 6.1.10, Fig 6-6).

5.2.6 CAPILLARY

Take the small plastic bag containing the capillary, Allen wrench and capillary insertion (setup) gauge out of the small parts box, clean and install capillary in transducer tip (Section 6.1.2, Fig 6-3).

6. SETUP, ADJUSTMENTS AND OPERATION

6.1 SETUP AND ADJUSTMENTS

Your bonder was carefully adjusted at the factory and tested on the type of device and bonding wire specified in your order. Ordinarily, if you use the same device and wire, this section will serve as a checklist for maladjustments that may have occurred in shipping. If you decide to bond other devices or change to a different type of wire, this section will guide you to make the necessary adjustments.

A distinctive feature of Model 4124 is ease of parameter setting. Many adjustments that required tools and mechanical procedures on earlier machines can be accomplished on Model 4124 by simply turning dials. Before setting up the machine, familiarize yourself with its control panels. With the Bonder installed in a still, draftless location for optimum performance, and warmed up for about 20 minutes, adjust the machine in the following sequence (transducer leveling is performed only on replacement).

6.1.1 TRANSDUCER REPLACEMENT AND LEVELING

6.1.1.1 Set power switch to OFF.

6.1.1.2 Remove present transducer as follows:

6.1.1.2.1 Unplug the transducer cable from the U/S jack on the logic board (Fig 11-8).

6.1.1.2.2 Cut the plastic strips that bind the transducer cable to the other wiring.

6.1.1.2.3 Loosen the 2 lock nuts of the transducer clamp’s u-bolt (Fig 3-8) and remove transducer.

6.1.1.3 Insert the cylindrical end of the replacement transducer into the u-bolt, tighten lock nuts somewhat, lead the transducer cable back to the U/S jack on the logic board and plug it in. Attach the cable to the Bonder wiring with plastic strips.

6.1.1.4 Insert the verticality pin into the tool hole of the new transducer and clamp it in place with the set screw at the tip of the transducer (Figure 3-8).

6.1.1.5 Adjust insertion depth of the transducer in the u-bolt so that the verticality pin is just in line with the EFO electrode and the drag jaws, viewed from the right (Fig 6-1).

6.1.1.6 While holding the transducer at the correct insertion depth, adjust its angular orientation by turning it with the fingertips (Fig 6-2). The verticality pin should line up with a

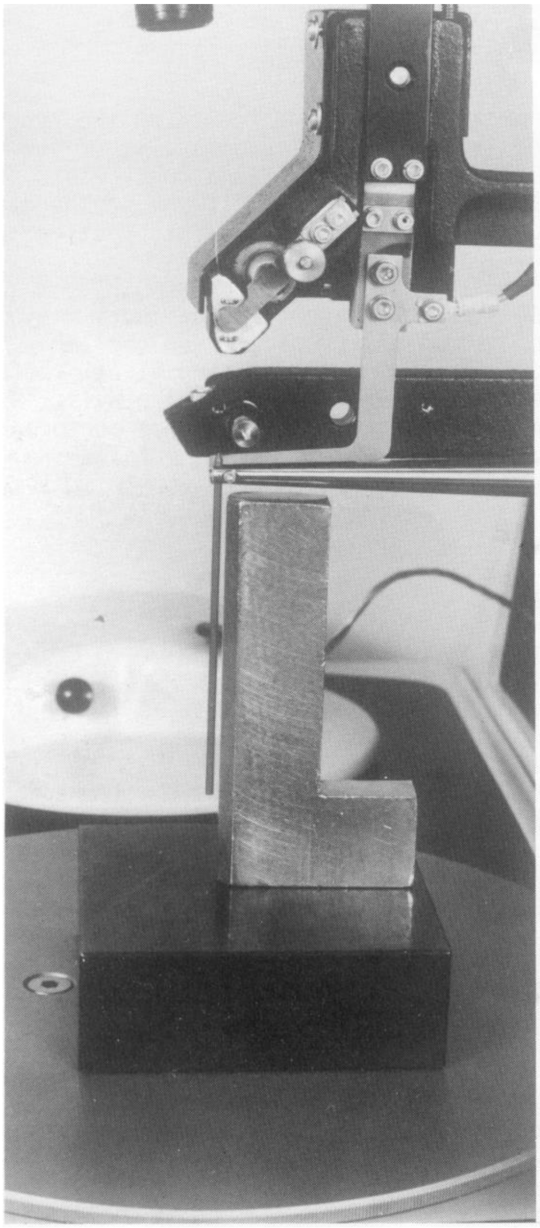


FIG. 6-1 TRANSDUCER INSERTION AND LEVELING ADJUSTMENTS

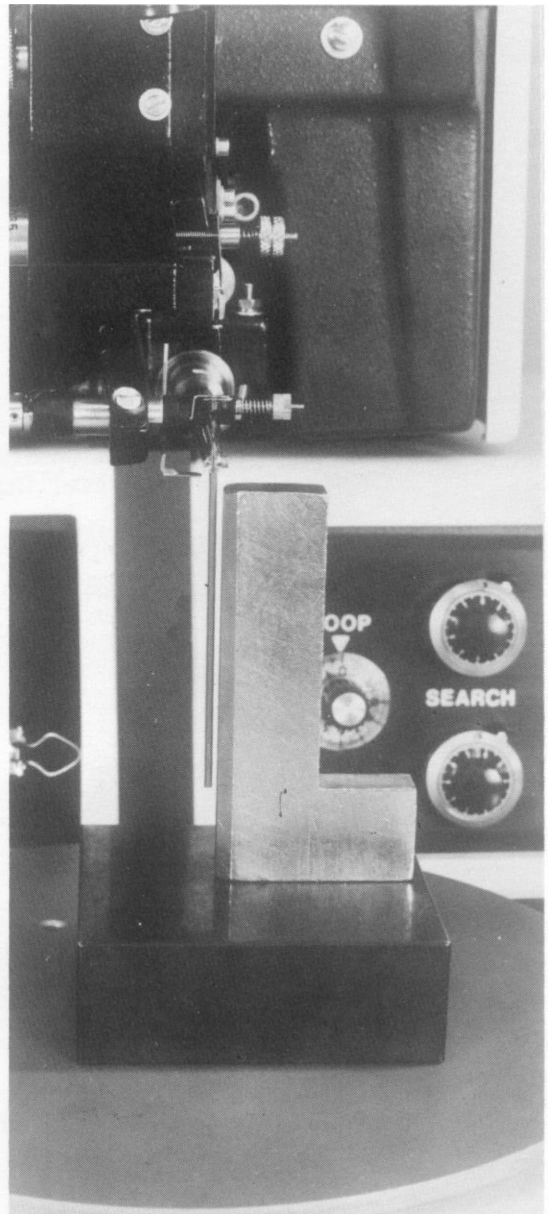


FIG. 6-2 TRANSDUCER ANGULAR ADJ.

square set on the workholder table. Tighten the 2 u-bolt lock nuts at a 7kg.cm torque.

6.1.1.7 Set MOTOR switch ON.

6.1.1.8 Bring bonding head to LOOP position.

6.1.1.9 Set LOOP dial to 0.0. When bonding head is at LOOP=0.0 position, the height control link should be vertical.

6.1.1.10 To level the transducer, view it from the side against a square set on the workholder table (Fig 6-1). Loosen the lock nut on the leveling screw so that when it touches the contact pin of the bonding head, the verticality pin lines up with the square set. Loosen the capillary set screw and remove the verticality pin from the transducer. Make sure that the ground connection is kept tight under the nut on the leveling screw (Fig 3-10).

6.1.2 CAPILLARY INSTALLATION IN TRANSDUCER

6.1.2.1 Bring bonding head to RESET position.

6.1.2.2 Loosen the capillary set screw at the transducer tip and insert the capillary. Set the capillary insertion gauge of the Bonder on the workholder. Lower the bonding head until the capillary tip touches the gauge and the transducer rests on top of the gauge (Fig. 6-3). Tighten capillary set screw.

NOTE: Ceramic capillaries are easily broken through misuse. When the machine is not operating, make sure that the tool lifter is in the upper position (Fig 3-9).

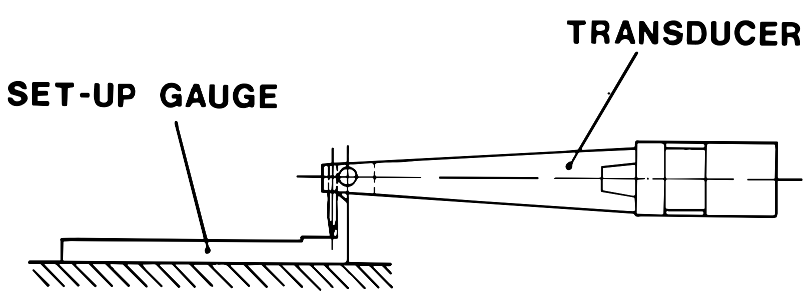


FIG. 6-3 CAPILLARY INSERTION ADJUSTMENT

6.1.2.3 Test for a tuned condition of the ultrasonic circuit: set TEST switch down momentarily and check that “U/S” on the right panel lights up. If it does not, readjust capillary insertion depth. Do not tighten the set screw too much against the capillary, as this may affect tuning.

6.1.3 WORKHOLDER ADJUSTMENT

To secure maximum range of bonding heights while preserving the required overtravel, it is desirable to adjust the workholder height so that a typical device placed on it will just touch the capillary tip when at the lowest possible SEARCH position (SEARCH = 0). The steady-state LOOP = 0 position, identical to it as regards bonding head placement, is preferred to permit workholder adjustment, but both SEARCH settings must also be zero.

6.1.3.1 Remove workholder from table.

6.1.3.2 Set MOTOR switch ON.

6.1.3.3 Set LOOP, 1st SEARCH and 2nd SEARCH dials all to 0.0.

6.1.3.4 Press and release CHESSMAN BUTTON to bring the bonding head to LOOP position, and watch for LED 2 short flash on the logic board (Fig 4-4), indication OVERTRAVEL beginning.

6.1.3.5 Place the workholder with the device on the table and adjust it for bare touch of the capillary on the device.

6.1.4 STATIC BONDING FORCE ADJUSTMENT

This adjustment is required only when changing to a bonding wire of different diameter. Thicker wires require greater force. The total force applied to the bond is the static force, adjusted by two counterweights on the bonding head, plus the dynamic force applied by the FORCE ACTUATOR. (The AIR DASHPOT damping effect is only incidental).

6.1.4.1 Set POWER switch OFF.

6.1.4.2 Disengage dashpot from connecting rod (Fig 3-9). Use tape to retain dashpot piston inside cylinder.

6.1.4.3 Place a force gauge under the capillary and adjust static force by rotating first the front counterweight then the rear one (Fig 3-9) to obtain an undamped force of 15-20 gr of the bonding head on the gauge, suitable for a 1 mil (25 microns) wire. Lock counterweight nuts.

6.1.4.4 Reconnect dashpot to connecting rod. Raise the front end of the bonding head and allow it to fall. The capillary tip should fall evenly.

6.1.4.5 If necessary, adjust the bleeder valve (Fig 3-9) to obtain the desired damping effect, which gives an even but not too slow drop of the bonding head when raised by hand.

6.1.5 WIRE CLAMP ADJUSTMENT

The clamp solenoid opens the wire clamp against the opposing force of a compressed spring. The solenoid is mounted on the bonding head frame just above the capillary. Clamp gap must be readjusted when replacing a solenoid or on clamp malfunction. Clamping force must be adjusted whenever you change to bonding wire of a different diameter (Fig 6-4).

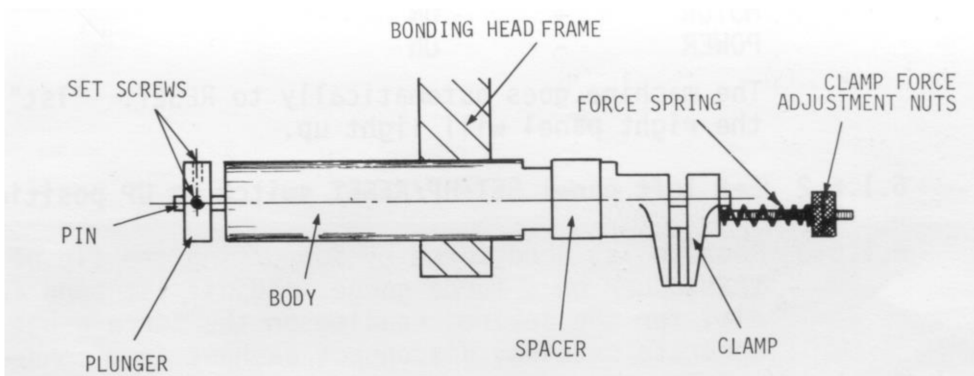


FIG. 6-4 WIRE CLAMP SOLENOID

6.1.5.1 Clamp gap:

6.1.5.1.1 Set switches as follows:

MOTOR - ON
POWER - ON

6.1.5.1.2 The clamp solenoid plunger projects beyond the solenoid body at the left of the bonding head. Press plunger against solenoid body, and while pressing check clamp gap with a feeler gauge for 5-7 mils (127-178 microns), suitable for a 1-3 mil (25-75 microns) wire.

6.1.5.1.3 Loosen 2 set screws on plunger. Shift plunger left on the pin to widen gap, right to narrow gap.

6.1.5.1.4 Tighten set screws.

6.1.5.2 Clamping force:

6.1.5.2.1 Press a force gauge against the left end of the clamp solenoid pin and read the force required to open the clamp.

6.1.5.2.2 Adjust clamping force by turning the two clamp force adjustment nuts (Fig 6-4). Set clamping force so that the wire will just tear when pulled. (100 gr min. gauge reading at a 5 mils (125 microns) gap.

6.1.6 SETTING BOND FORCES

6.1.6.1 Set switches as follows

MOTOR - ON
POWER - ON

The machine goes automatically to RESET. 1st LED on the right panel will light up.

6.1.6.2 Set left panel SET-UP/RESET switch to UP position.

6.1.6.3 Measure 1st Bond force by supporting the tip of the transducer on a force gauge. Adjust 1st bond FORCE dial for the desired reading on the force gauge. (For accurate setting, disconnect dashpot from connecting rod).

6.1.6.4 Set SET-UP/RESET switch to MID position.

6.1.6.5 Press and release CHESSMAN BUTTON to bring the machine to LOOP. The 2nd LED on right panel will light up.

6.1.6.6 Set SET-UP/RESET switch to UP position.

6.1.6.7 Measure 2nd bond force by supporting the transducer tip on the force gauge. Adjust 2nd bond FORCE dial until the desired reading is obtained.

6.1.6.8 Reconnect dashpot if disengaged.

6.1.7 SPOTLIGHT ADJUSTMENT (optional)

6.1.7.1 Manipulate the device to the smallest pad site where CHESSMAN bonding is required.

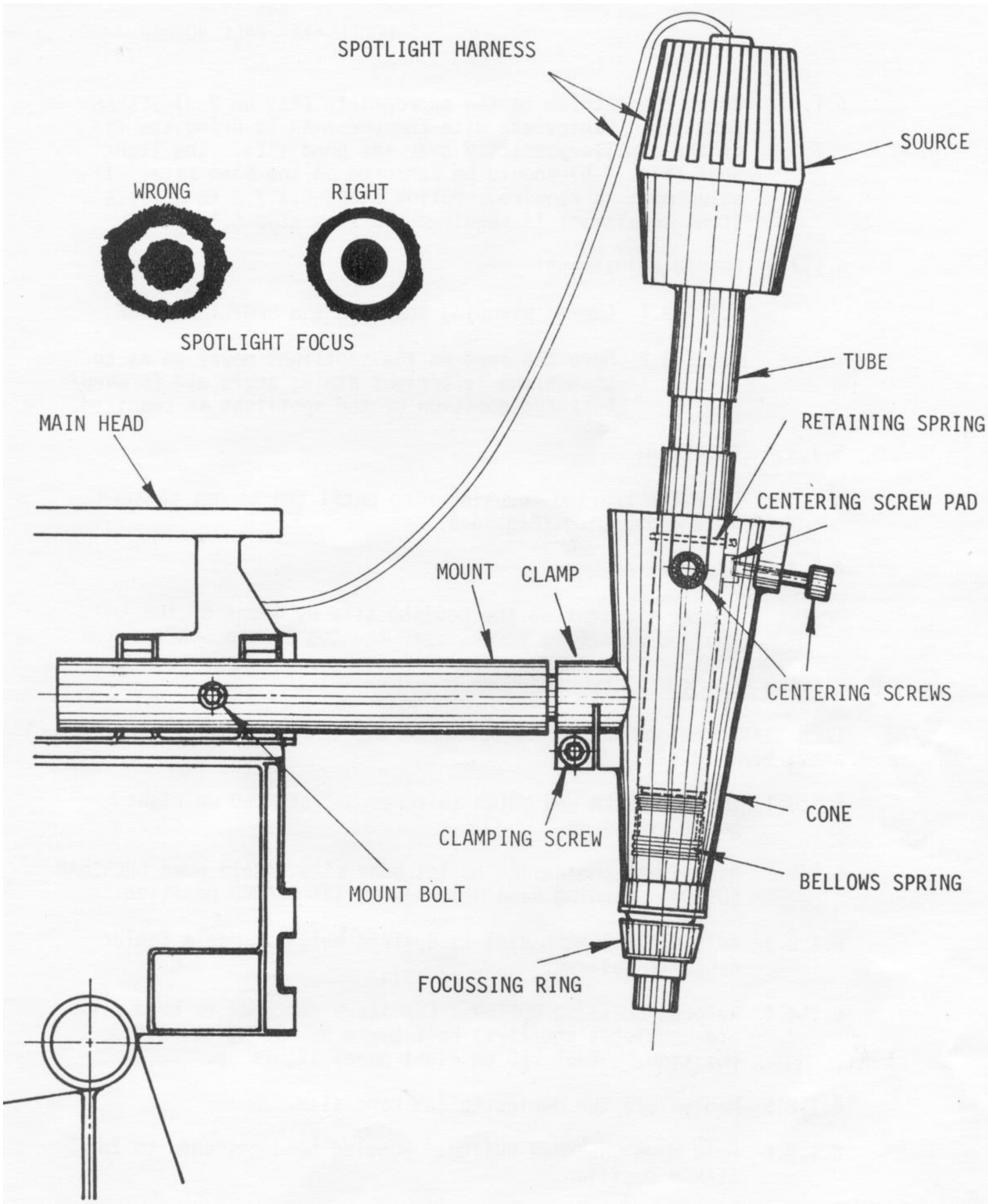


FIGURE 6-5 SPOTLIGHT MOUNTING AND ADJUSTMENT

6.1.7.2 Bring the machine to the appropriate (1st or 2nd) SEARCH position. Manipulate with the CHESSMAN to bring the tip of the capillary exactly over the bond site. The light spot (Fig 6-5) should be centered on the bond site. If adjustment is required, follow steps 6.1.7.3 to 6.1.7.5. If no adjustment us required, perform step 6.1.7.4.

6.1.7.3 Coarse adjustment:

6.1.7.3.1 Loosen clamping screw on the SPOTLIGHT CONE.

6.1.7.3.2 Move the cone on the spotlight mount so as to change the left/right aiming angle and forward/backward position of the spotlight as required.

6.1.7.4 Focusing:

Turn the knurled focusing ring until the target pattern is a sharp ring (Fig 6-5).

6.1.7.5 Fine centering:

Center the spot on the bonding site by means of the two knurled centering screws near the top of the CONE.

6.1.8 SETTING SEARCH HEIGHTS

Each SEARCH height should be set up at approximately 5 mils (0.127mm) above bonding level.

6.1.8.1 Turn on POWER and MOTOR switches. 1st LED on right panel lights up.

6.1.8.2 Manipulate the device to 1st bond site. Hold down CHESSMAN BUTTON. Bonding head descends to 1st SEARCH position.

6.1.8.3 Adjust 1st SEARCH dial to desired height. Use a feeler gauge if desired.

6.1.8.4 Release CHESSMAN BUTTON. Capillary descends to bond site and completes the first half-cycle by rising to LOOP position. 2nd LED on right panel lights up.

6.1.8.5 Manipulate the device to 2nd bond site.

6.1.8.6 Hold down CHESSMAN BUTTON. Bonding head descends to 2nd SEARCH position.

6.1.8.7 Adjust 2nd SEARCH dial to bring the capillary tip to about 5 mils (0.127 mm) above bond site.

6.1.8.8 Release CHESSMAN BUTTON. Bonding head descends to 2nd bond site, then rises to RESET. Search adjustments are complete.

6.1.9 LOOP ADJUSTMENT

6.1.9.1 Press and release CHESSMAN BUTTON. Machine cycles to LOOP position. 2nd LED on right panel lights up.

6.1.9.2 Set loop height as required, by LOOP dial on right panel. Take care that the LOOP dial should be at least 1 dial division (one tenth of a full turn) above the 2nd SEARCH dial setting.

6.1.10 WIRE LOADING

6.1.10.1 Remove plastic DUST COVER, SPOOL CAP and glass FEED TUBE from the SPOOL HOLDER. Place gold wire spool in spool holder (Fig 6-6A). A single-flanged spool is recommended.

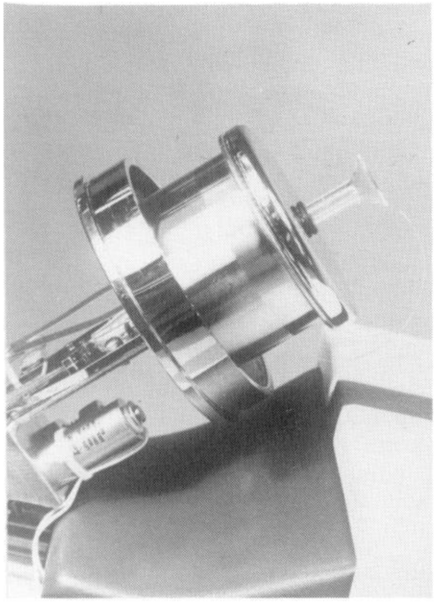
6.1.10.2 Hold the glass feed-tube in your hand and slip one of the rubber O-rings on the tube's pointed end. Slide it up until it is about 3/8" (9mm) from the tube's flared end. Insert the pointed end of the tube through the spool cap, from the top. Slip the second O-ring on the tube from below and slide it up until the tube is held fast between the two O-rings (Fig 6-6B). Place the spool cap with the tube on the spool holder, flared end upwards (Fig 6-6A).

6.1.10.3 Bring free end of the wire, as marked by the manufacturer on the spool, up over the polished circumference of the spool cap and insert it into the flared end of the tube. Push down through the tube until it comes out of the lower pointed end.

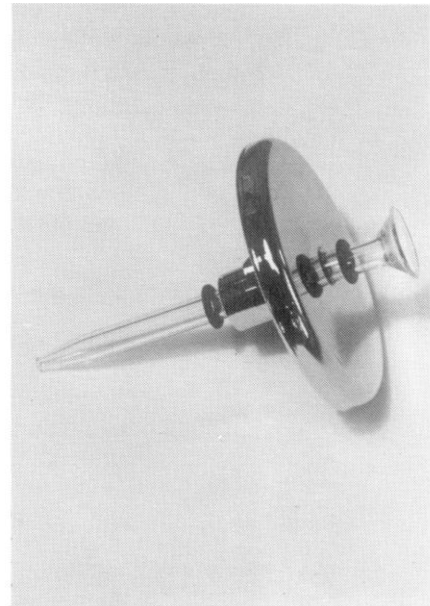
6.1.10.4 Place black plastic dust cover over spool holder (Fig 6-6C), taking care not to pinch the wire.

6.1.10.5 Set CLAMP switch to the UP position, to open both WIRE CLAMP and DRAG CLAMP jaws.

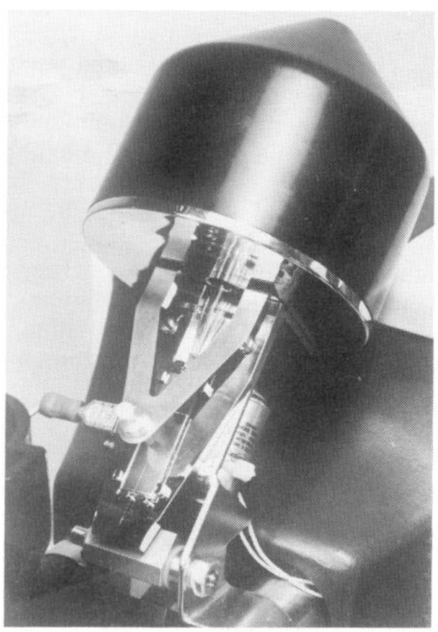
6.1.10.6 Using tweezers, grasp the small glass plate of the fixed tensioner (Fig 6-7D) and gently remove it from its seat. If necessary slightly lift the white plastic screw over the tensioner to clear the way. Pull wire tip along the tensioner route and thread it via the kicker link's wire



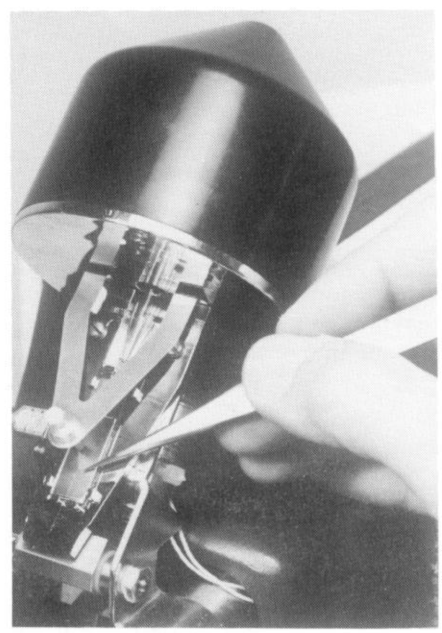
A. FEED TUBE ON SPOOL HOLDER



B FEED TUBE DRESSING



C. WITH DUST COVER



D. FIXED TENSIONER

guide. Make sure that the small glass plate is clear of dust, fat stains or fingerprints, and replace it on top of the wire on the fixed tensioner bracket, again lifting the screw if necessary. Also, make sure that the polished, rounded side of the glass plate is downwards, on the wire. Pull wire further through the wire guides of the drag clamp, the open jaws of the drag clamp and the open jaws of the wire clamp via its wire guide. Thread the wire down through the capillary, using tweezers.

NOTE: The wire should go along a straight line from the kicker down to the capillary, without bending; otherwise, friction may cause looping problems.

6.1.10.7 Set clamp switch to the DOWN position.

6.1.11 EFO ELECTRODE ADJUSTMENT

6.1.11.1 Electrode height adjustment:

6.1.11.1.1 Loosen the electrode slide’s lock screw on the left of the electrode slide, on the bonding head main bracket (Fig 3-8).

6.1.11.1.2 Turn the top-mounted electrode height adjusting screw so that the electrode horizontal tip is placed about 30-40 mils (0.76 – 1.02 mm) below the capillary tip, suitable for a 1 mil (25 microns) wire.

NOTE: In general, the greater the gap, the smaller the ball, and vice versa.

6.1.11.1.3 Tighten lock screw.

6.1.11.2 Electrode horizontal position adjustment:

6.1.11.2.1 Loosen the EFO SOLENOID clamping screw (Fig. 3-8)

6.1.11.2.2 Turn the solenoid with the fingertips until, in the RESET position, the electrode tip is about 4 mm from the capillary tip, on the left.

6.1.11.2.3 Tighten clamping screw.

6.1.11.3 Electrode overtravel adjustment:

6.1.11.3.1 Loosen the EFO SOLENOID tip two set screws.

6.1.11.3.2 Press the solenoid pin (Stop-washer) to the right until stopped by the solenoid body. Keep pressing.

6.1.11.3.3 Tilt the electrode manually so that its tip reaches 50-60 mils (1.25 – 1.5 mm) beyond the capillary tip, to the right. Keep pressing at this position.

6.1.11.3.4 Shift plunger right until stopped by the electrode insulator.

6.1.11.3.5 Tighten tip set screws.

6.1.12 SETTING BALL SIZE

6.1.12.1 EFO range high/low adjustment:

6.1.12.1.1 Open the main head left cover (door).

6.1.12.1.2 Set the EFO RANGE HIGH/LOW switch (Fig 3-9) to HIGH for a wire diameter of 2-3 mils (50-75 microns), and to LOW for a diameter of 0.7-2 mils (18-50 microns).

6.1.12.1.3 Close the left cover.

6.1.12.2 Set BALL SIZE ADJ. selector on the EFO panel to the desired value. The recommended ball diameter is 2-3 times the wire diameter. In general, a higher spark power makes a larger ball.

6.1.13 KICKER ADJUSTMENT

6.1.13.1 Kicker position adjustment:

6.1.13.1.1 Release kicker lock screw (Fig 3-12) and shift kicker assembly including spool holder forwards or backwards so that the link’s wire guide is just above the capillary.

6.1.13.1.2 Tighten kicker lock screw.

6.1.13.2 Kicker stroke adjustment:

While the device is being manipulated with the workholder, the kicker must feed just enough wire for two bonding (one loop), so that when the machine is in the 2^{nd} SEARCH position, there will be no slack left in the wire.

6.1.13.2.1 Loosen the two set screws of the KICKER SOLENOID tip.

6.1.13.2.2 Place the upper stop-washer of the solenoid pin at a gap of about 35 mils (0.9mm) from the solenoid body. Keep holding at this position.

6.1.13.2.3 Let the tip drop down on pin until stopped by the kicker pivot housing (base) when at released (backward) position.

6.1.13.2.4 Tighten set screws.

6.1.14 FIXED TENSIONER ADJUSTMENT

6.1.14.1 Bond a very long loop.

6.1.14.2 Bond a very short loop.

6.1.14.3 Observe the loops. If the long loop is either too high or sagging, tighten somewhat the white plastic screw of the fixed tensioner (Figure 6-6D) so as to put more pressure on the glass plate. If the short loop is either too low or too tight, loosen the screw somewhat for smaller pressure.

6.1.15 DRAG ADJUSTMENT

The function of the drag clamp is to seat the ball against the capillary tip before the 1^{st} bond, stretching the wire slightly just above the ball. Moreover, when bonding devices have considerable height difference between the two bonds, mainly in hybrid types, the wire tension so produced strain-hardens the section just above the ball and improves the stability of the resulting long loops.

6.1.15.1 Drag clamp gap adjustment:

6.1.15.1.1 Loosen the two set screws on the DRAG SOLENOID tip.

6.1.15.1.2 Press the solenoid pin (stop-washer) right until stopped by the solenoid body.

6.1.15.1.3 Place the solenoid jaws at a gap of 25-30 mils (0.6-0.7 mm). Keep pressing at this position.

6.1.15.1.4 Shift solenoid tip right until stopped by the right jaw leaf spring.

6.1.15.1.5 Tighten set screws.

6.1.15.2 Drag clamp force adjustment:

6.1.15.2.1 Rotate the drag clamp adjusting nut to obtain the required force.

NOTE: Higher force is required for higher loops, but excessive force may cause the wire to break just above the ball.

NOTE: THE FOUR FOLLOWING ITEMS – TAIL LENGTH, MAIN LVDT, Z-LVDT, U/S FREQUENCY – ARE FACTORY ADJUSTED AND SHOULD **NOT** UNDERGO NEW ADJUSTMENT EXCEPT UNDER SPECIAL CIRCUMSTANCES.

6.1.16 TAIL LENGTH ADJUSTMENT

Tail length is the amount of wire left below the capillary tip prior to ball formation. Tail length is preadjusted electronically at the factory to 20-25 mils (0.5 – 0.6 mm). To readjust, insert a screwdriver through the base back-cover and turn TAIL trimmer (Fig 4-4, 11-8). A clockwise turn reduces tail length, and vice versa. Tail length does not depend on 2^{nd} bond height.

6.1.17 MAIN LVDT ADJUSTMENT

6.1.17.1 Open main head right door and make sure that the LVDT core is fully screwed onto the PUSH ROD, to the end of threading (Figure 3-10).

6.1.17.2 Loosen rod end lock nut (Fig 3-10) and screw the rod so that the core is placed well within the LVDT body.

6.1.17.3 Set MOTOR switch OFF.

6.1.17.4 Set POWER switch ON.

6.1.17.5 Rotate cam to position it so that its small circular casting indentation is just opposite the CAM FOLLOWER of the HEIGHT CONTROL LINK (Fig 3-10).

6.1.17.6 Screw the main LVDT push rod in or out until LED 1 (RESET indicator) on the logic board (Fig 4-4, 11-8) lights up. Tighten rod end lock nut.

6.1.17.7 Turn MOTOR switch ON.

6.1.17.8 Press and release CHESSMAN BUTTON twice to run the machine through a single cycle. LED 1 on the logic board should light up at the end of cycle, with the motor at rest.

6.1.18 Z-LVDT ADJUSTMENT

6.1.18.1 Loosen on base back-cover (Fig 4-4) 3 screws of the right base cover (Fig 3-1) and slide it right off the base, to expose Z-LVDT. BEWARE OF MOTHERBOARD HIGH VOLTAGE!

6.1.18.2 Make sure that the Z-LVDT core is fully screwed onto the push rod, to the end of threading, and locked with the LVDT CORE lock nut (Fig 3-11, 3-15).

6.1.18.3 Loosen rod end lock nut (Fig 3-11, 3-15) and screw rod so that the core is placed well within the LVDT body.

6.1.18.4 Set MOTOR switch OFF. (POWER switch is ON).

6.1.18.5 Connect a DVM positive probe to pin 4 of connector P14 on the logic board (Fig 11-8).

6.1.18.6 With the Z-lever at the upper position (RESET), adjust the screw at the front end of the Z-LVDT body (Fig 3-15) for +7.6 Vdc on the DVM. Tighten screw nut.

6.1.18.7 Lower Z-lever to the lowest position and adjust the lower limit screw on the front (Fig 3-15) for –8.5 Vdc on the DVM.)

6.1.18.8 Raise the Z-lever back to RESET and adjust the upper limit screw on the front for a slight rise of the capillary (free play of 5-8 mm at finger tab) before Z-LVDT is engaged.

6.1.18.9 With Z-lever at the highest point, partially loosen the two flag screws and adjust flag tip to rest within the optocoupler slot. Tighten screws.

6.1.18.10 Set MOTOR switch ON, press and release CHESSMAN BUTTON twice to run the machine through a single cycle, and verify that LED 2 on the logic board flashes twice (at OVERTRAVEL) while LED 1 lights up at the end of cycle.

6.1.18.11 Set MOTOR to OFF and mount base cover.

6.1.19 U/S FREQUENCY ADJUSTMENT

6.1.19.1 Unplug transducer cable from U/S jack on the logic board (Fig 11-8)

6.1.19.2 Measure frequency at test point TP1 on the logic board and adjust trimmer-potentiometer R153 for 58.5 – 59.5 kHz, measured on a frequency counter.

6.1.19.3 Plug in cable.

6.1.20 TEMPERATURE CONTROLLER REPLACEMENT AND ADJUSTMENT

6.1.20.1 Set Bonder POWER switch OFF and unplug power cord.

6.1.20.2 Remove back and left covers of Bonder base, taking care not to damage the chessman wire.

6.1.20.3 Disconnect all wires from rear terminals of controller. Using Allen wrench 1/8", loosen the two side-holder screws (Fig 3-14) and remove controller.

6.1.20.4 Insert new controller into the front panel and fasten the two holders.

6.1.20.5 Connect labeled wires to rear terminals A-G as indicated in the printed table on top cover of the controller. Terminal G is for chassis grounding.

6.1.20.6 Plug the workholder cable into the Bonder "W.H." jack.

6.1.20.7 Plug power cord into mains and set POWER switch ON.

6.1.20.8 Allow controller to warm up for at least 20 minutes.

6.1.20.9 Adjust set-point by pressing DISPLAY SELECT pushbutton and turning SET POINT knob (Fig 4-1) for the desired temperature as displayed.

6.1.20.10 Adjust zero offset as follows:

6.1.20.10.1 Measure the workholder temperature with an auxiliary digital thermometer, using the workholder clamp to attach the sensor.

6.1.20.10.2 If the reading displayed on the controller is not the same as that of the digital thermometer, insert a small screwdriver through the hole in the controller front panel (Fig 4-1) and turn ZERO OFFSET adjustment screw for full identity between the two. Remove digital thermometer.

6.1.20.11 Adjust proportional band as follows:

Insert a small screwdriver through the hole in the controller to cover and turn PROPORTIONAL BAND adjustment screw (Fig 3-14) to obtain variations of temperature around the set point, compensating for effects due to differences in heat capacity between different types of heater blocks/

6.1.20.12 If the two OPEN T.C. LEDs light while the DISPLAY digits are blank, the thermocouple circuit is open.

6.1.20.13 If the LOAD ON LED lights or flashes, the output load is being heated.

6.2 OPERATION

When all settings and adjustments have been accomplished, try machine performance as follows:

6.2.1 Set 1st and 2nd bonds' POWER and TIME dials as desired, at some mid-position.

6.2.2 Bond a number of loops, re-setting POWER and FORCE respectively until optimum bonds are finally obtained. If necessary, set U/S POWER HIGH/LOW switch within the base back-cover to the other position.

6.2.3 Make a ball by using the EFO red pushbutton.

6.2.4 Bond a number of loops in the manual Z mode, gently lowering the Z-lever down to its bottom stop at each bond. With all parameters already set, only LOOP is now operator-dependent.

6.2.5 Test stitch bonding by bonding several stitches, pressing STITCH BUTTON after the 1st bond and releasing it before the last, for prevention of wire tear and securing continuous loopings:

In chessman mode, first press and release CHESSMAN BUTTON as for ordinary 1st bonds. Then press STITCH BUTTON, keep pressing and repeat using the CHESSMAN BUTTON, applying the “2nd bond” parameters to all following bonds (stitches). Before the last bond, release STITCH BUTTON and use CHESSMAN BUTTON one more time as for an ordinary “2nd bond”, terminating the stitch series.

In manual Z mode, use the STITCH BUTTON alone, holding it in just as above and disregarding the CHESSMAN BUTTON as in ordinary manual Z bondings.

7. BONDING CYCLE DESCRIPTION

The machine cycle is shown by a time study (Fig 7-1) and illustrated by sketches of both the CHESSMAN bonding cycle (Fig 7-1) and the MANUAL Z bonding cycle (Fig 7-3). The stitch bonding option, possible in both modes, is illustrated in the second only.

7.1 MECHANICAL

Capillary motion in the CHESSMAN mode is characterized by high initial acceleration caused by the servo system, with the Tracking force and the net counterweights static balance just overcoming air dashpot damping to keep the CONTACT PIN connected to the HEIGHT CONTROL LINK; a moderate constant-speed drop impeded by increased air dashpot damping; and a slow approach to the 1st SEARCH position as determined by the servo system. When CHESSMAN BUTTON is released, the capillary drops further onto the device at a rather slow, nearly constant speed dictated solely by the air dashpot, with the Constant force now just maintaining contact between actuator and bonding head. The motor-cam-LVDT mechanism is now quicker than the bonding head, therefore it continues separately, disconnecting the CONTACT PIN, to its extreme forward position – corresponding to OVERTRAVEL if the bonding head were allowed to follow (broken line in the time study). The 1st Bond force (F1) is then applied by the FORCE ACTUATOR to the bonding head heel ball, with the motor-cam-LVDT mechanism unaffected. Finally, after 1st bond has been accomplished, the combined mechanism rises evenly and smoothly, reconnecting the PIN CONTACT at "0" height, to near LOOP position where motion is slowed down again by the servo system. The 2nd bond follows a similar line.

Capillary motion in the MANUAL Z mode is simpler and more straightforward, following directly the Z-lever manual motion (assumed linear in the diagram), until back in CHESSMAN mode at 2nd rise (to RESET). However, as the Tracking force is not available from the logic in this case, 1st Bond force F1 and 2nd Bond force F2 are extended in time to fill this role, starting off together with the capillary descent and terminating as in chessman mode.

7.2 ELECTRICAL

7.2.1 Delay ΔT1 is the time interval required foe the logic, once the LVDT core has reached its foremost position, to initiate both 1st Bond (F1) and U/S Power pulses, which are of equal duration as per 1st TIME dial setting, but of individual levels as set by the corresponding FORCE and POWER dials.

7.2.2 Delay ΔT2 is the time interval required for the logic, once the 1st bond has been accomplished, to initiate motor-cam-LVDT reversal and capillary pull-up to LOOP position.

7.2.3 Height ΔZ is the level where the logic initiates wire clamp closing for proper tail formation, producing a small time delay after the PIN CONTACT has closed the circuit. ΔZ is adjusted electronically.

7.2.4 Delay ΔT3 is the time interval required for the logic to initiate the EFO, allowing the capillary first to stabilize mechanically at RESET position.

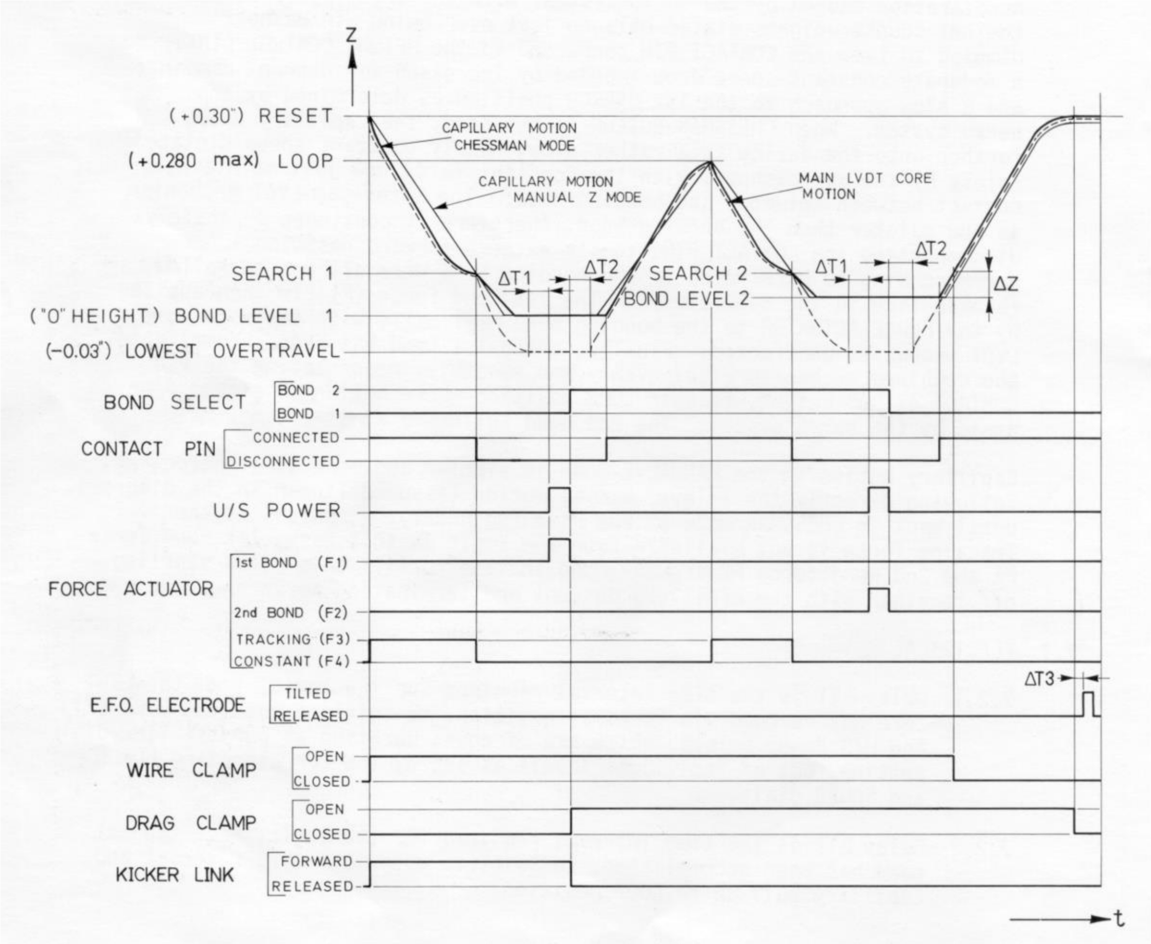


FIG. 7-1 BONDING CYCLE TIME STUDY

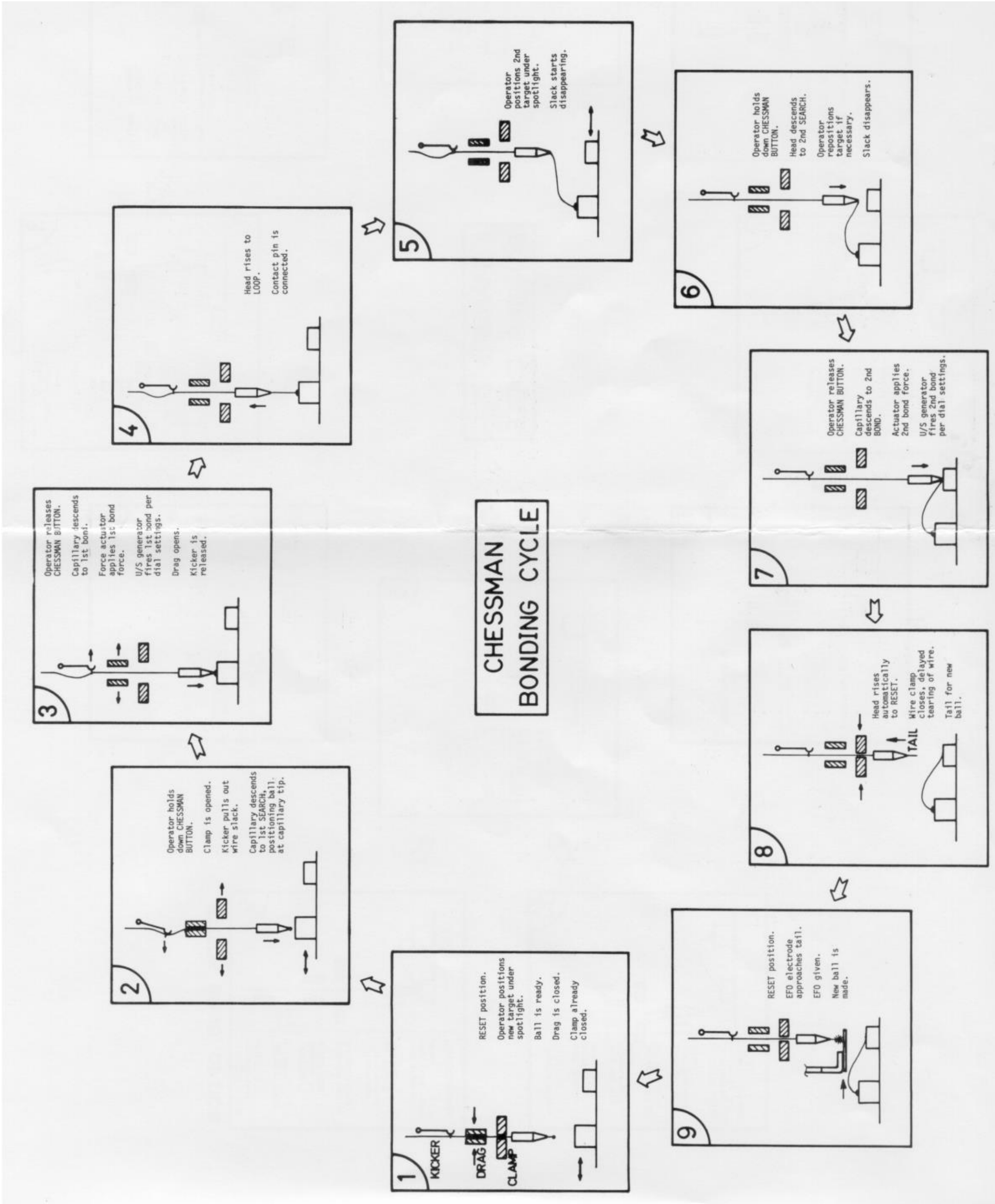


FIG. 7-2 CHESSMAN CYCLE PHASES – GRAPHIC ILLUSTRATION

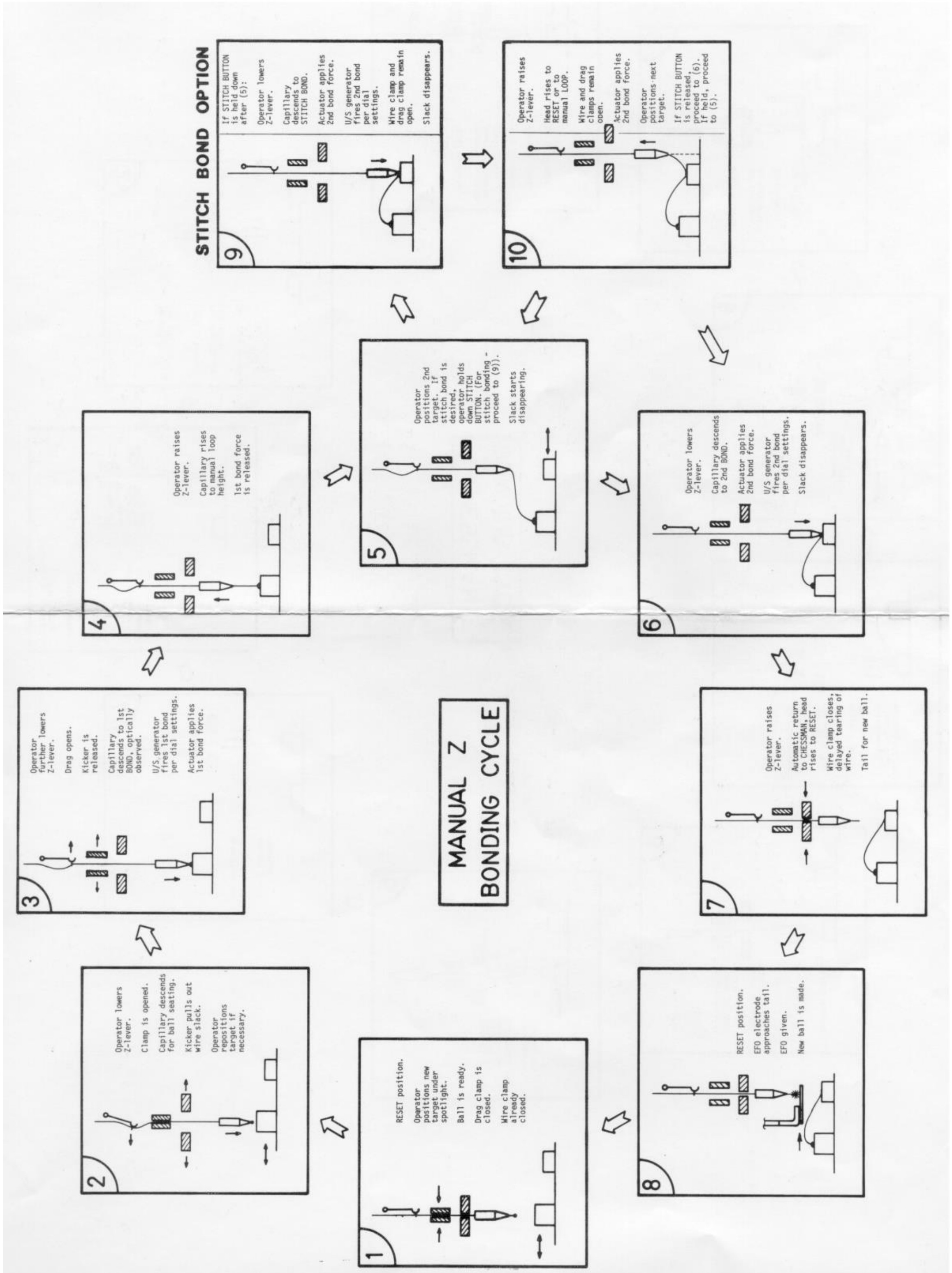


FIG. 7-3 MANUAL Z CYCLE PHASES – GRAPHIC ILLUSTRATION

8. CONDITIONS AND ADJUSTMENTS FOR OPTIMUM BONDING

Optimum bonding conditions are a function of wire diameter and hardness, as well as device bondability. The following instructions are given for a 1 mil (25 microns) wire of 2-4% elongation.

Optimum adjustment should produce a near-perfect ball of proper size (Fig 8-1), a neat stable ball bond (Fig 8-1), a fine loop (Fig 8-3), and a solid 2nd bond permitting proper wire tear (Fig 8-5).

In this context, it is always important to verify a stable windless work area and a perfectly clean smooth wire pathway, in particular over the polished spool cap and under the polished rounded face of the fixed tensioner glass plate. Also, verify that the wire stands vertical over the capillary, viewed both from the front and from the side.

In performing the following adjustments, follow the detailed instructions given in the respective paragraphs of Section 6.

8.1 STATIC FORCE

With mains power off and air dashpot disconnected, adjust front and rear counterweights for 20-25 gr on a force gauge.

8.2 WIRE CLAMP

8.2.1 Adjust clamp gap for 5-7 mils (127-178 microns).

8.2.2 Adjust clamp force to the point of tearing the wire when pulled gently under its closed jaws (clamping force of 100 gr min.).

8.3 TAIL LENGTH

Tail length is adjusted at the factory for all wires and should not be tampered with. If however, required under exceptional circumstances, readjust tail length for 20-25 mils (0.5 – 0.6 mm).

8.4 EFO ELECTRODE

Adjust electrode for a vertical gap of 30-40 mils (0.75 – 1.00 mm) to the capillary tip, a horizontal distance of 4 mm when at rest, and a horizontal overtravel of 50-60 mil (1.25 – 1.5 mm).

8.5 KICKER

Adjust kicker solenoid for a stroke of 35 mils (0.9 mm) of the solenoid tip (for ordinary loop length). For zero height difference, a smaller stroke is adequate.

8.6 DRAG CLAMP

8.6.1 Adjust drag gap for 25-30 mils (0.6 – 0.7 mm).

8.6.1 Adjust drag force for proper ball seating at capillary tip when descending, increasing the force somewhat for higher loops.

8.7 FIXED TENSIONER

Adjust fixed tensioner pressure so that long loops are not high or sagging, while short loops are not too low or tight: in the first case, increase pressure as necessary; in the second, loosen a little (Fig 8-4).

8.8 BALL SIZE

Set EFO power (BALL SIZE ADJ. selector) for a ball diameter of 2-3 mils (50-75 microns), with the EFO RANGE HIGH/LOW switch on LOW.

For thicker wires of 2-3 mils (50-75 microns), set the switch to HIGH and the selector as required for a ball size 2-3 times the wire diameter (Fig. 8-1).

8.9 CONTROL DIALS

Parameter dials are set largely by experience and trial-and-error approach.

8.9.1 Set FORCE and TIME dials for stable (sticking) bonds. Avoid excessive force to prevent cracking or chipping, and excessive time to prevent weakening of bonds already formed.

8.9.2 Set SEARCH dials for approx. 5 mils (0.127 mm) above bond levels (pads).

8.9.3 Set LOOP dial for the desired loop height, but always at least one dial-division (one tenth of a full turn) above the 2^{nd} SEARCH setting. This adjustment, together with the above wire-feed adjustments, determines the final shape and quality of the loops.

8.9.4 Set 1^{st} POWER dial between 0.6-2 turns and 2^{nd} POWER dial between 3-5 turns, with rear U/S POWER HIGH/LOW switch on LOW.

8.10 WORKHOLDER TEMPERATURE

Adjust the temperature controller for the highest temperature that the device will tolerate, up to 180ºC. In devices having contact pins mounted in ceramic or glass (mainly hybrid types), ultrasonic power may be lost if the pin is not firmly mounted. In such cases, a heated capillary kit can be provided as an accessory (Section 12), supplementing the ultrasonic power with a thermocompression effect. The advantage is that the high temperature is confined to the capillary and does not heat the whole device.

FIG. 8-1 THE BONDING BALL

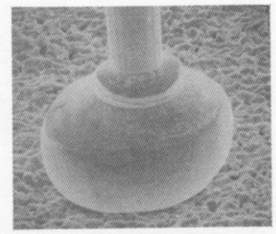
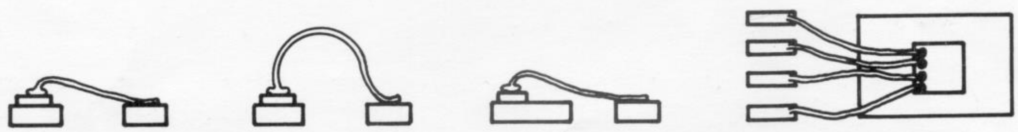


FIG. 8-2 THE 1ST BOND

SIDE VIEW

TOP VIEW

FIG. 8-3 THE GOOD LOOP



TOO FLAT

TOO HIGH

SAGGING LOOP

SIDE VIEWS

TOP VIEW

FIG. 8-4 THE BAD LOOP

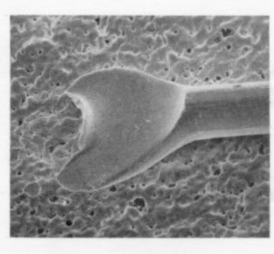


FIG. 8-5 THE 2ND BOND

9. TROUBLESHOOTING

9.1 Area light and/or spotlight do not light

9.1.1 Check fuses F5 on mother board (area light).

9.1.2 Check fuse F6 on mother board (spotlight)

9.1.3 Check for 12 Vdc across CR2 on mother board.

9.1.4 Replace lamps.

9.2 Motor does not run from RESET to LOOP

9.2.1 Check CHESSMAN switch.

9.2.2 Check fuses F3 and F4 on mother board.

9.2.3 Check U43 output for +15 Vdc on logic board.

9.2.4 Check U41 output for –15 Vdc on logic board.

9.2.5 Check for 13 Vdc at terminal P7-5 on logic board.

9.3 Cycle runs continually without stopping

9.3.1 Check CHESSMAN switch.

9.3.2 Check for 18 V ptp, 2.5 kHz sine wave at terminal P14-6 on logic board.

9.3.3 Check for 0 Vdc between terminals U1-2 and U1-3 on logic board.

9.3.4 With MOTOR switch OFF, rotate cam until LED 1 (RESET) lights up on logic board. Check for 7 Vdc at terminal P14-5 on logic board.

9.3.5 Set MOTOR switch ON and check for less than 6 Vdc at P14-1.

9.4 All solenoids do not operate

9.4.1 Check for 30 Vdc across capacitor C1 on logic board.

9.4.2 Check fuse F1 on logic board.

NOTE: In all electrical measurements, tolerance is 5%.

9.5 U/S does not light

9.5.1 Check that transducer cable is plugged securely into U/S jack on logic board (Fig 11-8).

9.5.2 Check that transducer is at proper insertion depth and clamped tightly.

9.5.3 Check that capillary is secured to transducer at proper insertion depth. Check that clamping force on the capillary is not excessive.

9.5.4 Check for 59.5 – 60.5 kHz at TP1 on logic board. Unplug transducer cable and check for 58.5 – 59.5 kHz at TP1. Plug in cable.

9.5.5 Press TEST switch and check for sine wave greater than 1.2 V ptp at TP3 on logic board.

9.5.6 While pressing TEST switch check that the voltage at U3-5 on logic board is higher than at U3-6.

9.6 Force actuator does not operate

9.6.1 Check Q4 output for 8 Vdc on logic board.

9.6.2 Unplug force actuator cable from logic board (Fig 11-8) and check for 7 Ohms across force actuator coil. Reconnect cable.

9.6.3 Bring cycle to SEARCH position and check for more than 240 mV dc across R21 on logic board

9.6.4 Check that the actuator coil is not stuck.

9.7 Excessive noise in cycle

9.7.1 Defective mechanical linkages through damaged, loose or lost parts.

9.7.2 Check height control link's return spring.

9.8 Machine jolts during bonding cycle

9.8.1 Mechanical interference with cam rotation, such as by link's cam follower.

9.8.2 Drive belt loose.

9.8.3 Air dashpot maladjusted.

9.9 Bonds do not stick

9.9.1 Insufficient power, force or bonding time.

9.9.2 SEARCH position is too high, therefore capillary does not contact device.

9.9.3 Poor or dirty bonding surface. Clean device by soaking in Isopropyl alcohol. Also try new device.

9.9.4 U/S generator out of order. Check tuning.

9.9.5 Check workholder temperature and height.

9.9.6 Check transducer cable connection to U/S jack on logic board.

9.9.7 Check that transducer and capillary are at proper insertion depths and clamped firmly.

9.10 Ball bonds are heavily squashed

9.10.1 1st Bond force, power or time too high.

9.11 Balls are improperly shaped

9.11.1 Ball is too large. Reduce EFO settings.

9.11.2 Tail is too long, causing tail to swing about as ball is formed.

9.11.3 Ball is not seated at capillary tip due to insufficient drag. Tighten drag solenoid.

9.12 Ball if off center (“Golf Club” ball)

Ball is not seated at capillary tip before 1st bond. Tighten drag solenoid.

FIG. 9-1 "GOLF CLUB" BALL

9.13 Ball is too large

BALL SIZE ADJ. setting too high, or EFO RANGE HIGH/LOW switch at HIGH position. If still too high at minimum setting, lower the electrode for a larger vertical gap. If necessary, replace ele3ctrode series resistor of 47 kOhm by a higher value, on the EFO board.

9.14 Ball size is inconsistent

9.14.1 Operator is trying to maintain ball size too small or too large.

9.14.2 Fluctuating power supply to EFO.

9.14.3 Drafts at the operating area (air conditioning).

9.14.4 Tail length is not constant after 2nd bond. Increase wire clamp force. Check for internal clamp solenoid friction causing clamping delay.

9.14.5 Electrode-capillary gap too large, too small or inconsistent.

9.15 Ball apparently sticking, then detaches with rising capillary

9.15.1 Not enough bonding area. Bond too close to edge of pad.

9.15.2 Insufficient 1st Bond force, power or bonding time.

9.15.3 Transducer out of order or not properly connected to U/S jack on logic board.

9.15.4 Ultrasonic generator out of order. Check tuning.

9.16 Wire breaks just above first bond

9.16.1 Power is too high.

9.16.2 Fixed tensioner too tight.

9.16.3 Wire clamp operation not properly timed. Check contact pin adjustment and electronic delay circuit.

9.16.4 Drag clamp too tight.

9.17 Wire breaks at any point during cycle

9.17.1 Fixed tensioner too tight

9.17.2 Capillary is broken.

9.17.3 Wire clamp is closed or nearly closed when it should be open.

9.17.4 Wire is bound or held somewhere along wire line. Check for dirt or scratches.

9.18 Loop height varies

9.18.1 Fixed tensioner not stable.

9.18.2 Drag clamp not stable

9.18.3 LOOP dial not properly adjusted (mainly with low, short loops).

9.18.4 Capillary is clogged at tip.

9.19 Loop is too tight

9.19.1 Fixed tensioner too tight

9.19.2 Wire clamp closes before capillary comes down on 2^{nd} bond.

9.19.3 Wire is bound or held on obstructions along wire line, such as dirt or scratches.

9.20 Loop too high or sagging

9.20.1 Wire line not tight. Adjust fixed tensioner.

9.20.2 Operator has manipulated too far past 2^{nd} bond pad, drawing too much wire through capillary.

9.20.3 Capillary is defective.

9.21 No ball is formed after EFO

9.21.1 Little or no tail

9.21.2 Electrode not properly adjusted.

9.21.3 Drafts at operating area (air conditioning).

9.21.4 Electrode-wire gap too large.

9.21.5 BALL SIZE ADJ. selector setting too low.

9.21.6 No EFO voltage. Press EFO pushbutton, and while pressing, check for 1200 Vdc on electrode.

9.22 Clamp solenoid does not function properly

9.22.1 Check connections between logic board and the solenoid

9.22.2 Check transducer Q2 on logic board.

9.22.3 Check for presence of positive triangular wave at terminal U37-2 on logic board.

9.22.4 Clamping force too high.

9.22.5 Solenoid gap too high.

9.23 <u>Drag solenoid does not function properly</u>

9.23.1 Check connections between solenoid and logic board.

9.23.2 Check transistor Q1 on logic board.

9.23.3 Check for presence of positive triangular wave at terminal U37-2

9.24 <u>EFO solenoid does not function properly</u>

9.24.1 Check connections between solenoid and logic board.

9.24.2 Check for short pulses at terminal U30-10 on logic board.

9.24.3 Solenoid gap is too high.

9.24.4 Clamping force is too high.

9.25 <u>Kicker solenoid does not function properly</u>

9.25.1 Check connections between logic board and the solenoid.

9.25.2 Check for presence of positive pulses at terminal U34-5.

9.25.3 Solenoid gap is too high.

9.26 <u>Capillary is clogged at tip</u>

9.26.1 Dust and dirt accumulation. Clean in Trichlorethylene, if possible inside a small ultrasonic cleaning bath. Blow air into tip.

9.26.2 A piece of wire lodged at tip. Lower capillary into an existing bonded ball that is at working temperature to facilitate unclogging.

9.27 <u>Manual Z does not function properly</u>

9.27.1 Defective photocell unit.

9.27.2 Fault in Z-LVDT system.

9.27.3 Broken or loose linkage in Z-lever mechanism.

9.27.4 Excessive height difference between 1st and 2nd bonds.

9.27.5 Check P14-4 on logic board for +7.7 Vdc at RESET and for –8.5 Vdc at OVERTRAVEL.

9.28 Stitch bonding does not function properly

9.28.1 Defective STITCH switch.

9.28.2 Wrong capillary.

9.29 Workholder is not heating

9.29.1 Disconnect heated type (180W) workholder and check between terminals 3 and 7 of its connector for resistance as follows:

Line voltage 100-120 Vac	-	80 Ohms approx.
Line voltage 220-240 Vac	-	320 Ohms approx.

9.29.2 Connect workholder and check for mains voltage (ac) between rear terminals C and D of the temperature controller.

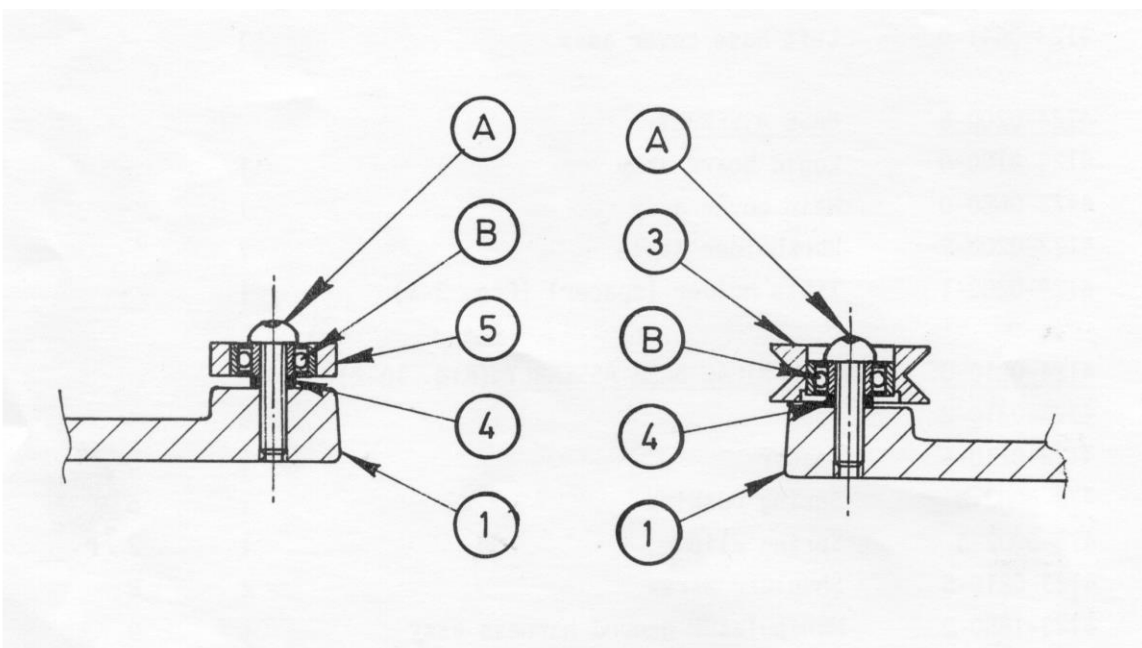
9.29.3 Check for 0 Vac between rear terminals E and F of the temperature controller. If not zero, check internal fuse of temperature controller.

10. PARTS LIST AND SPARE PARTS KIT

10.1 PARTS LIST

K&S PART NO.	DESCRIPTION	QUANTITY	ITEM
4124-0000-0	MODEL 4124 BALL BONDER (Fig 3-1)		
4124-7200-0	Manual Z Ass'y (optional) (Fig 3-15)	1	-
4124-7300-0	Spotlight Ass'y (optional)	1	-
4461-0000-0	Temperature Controller (Fig 4-1) KTC-101-1 Type J (115V)	1	-
4471-0000-0	Temperature Controller KTC-101-2 Type J (230V)	1	-
4123-0310-0	Main Head Right Cover Ass'y	1	-
4123-0320-0	Main Head Left Cover Ass'y	1	-
4123-0350-0	Microscope Holder Ass'y	1	-
4123-1830-0	Area Light Ass'y	1	-
4124-0000-2	Solenoids Cover (Fig 3-8)	1	-
4123-0631-0	Right Base Cover Ass'y	1	-
4123-0641-0	Left Base Cover Ass'y	1	-
4124-0200-0	BASE ASSEMBLY		
4124-4100-0	Logic Board Ass'y	1	-
4123-0650-0	Main Cover Ass'y	1	-
4123-0200-9	Workholder Table	1	-
4124-0200-1	Table Holder (spacer) (Fig 3-3)	1	-
4124-0210-0	MECHANICAL BASE ASSEMBLY (Fig 10-2)		
4123-0210-2	Foot	3	4
4123-0210-4	Spacer	1	5
478-5002-8	Spring Bushing	1	6
478-5002-5	Spring Clip	1	7
4123-0210-5	Shoulder Screw	2	8
4123-1850-0	Manipulator Ground Harness Ass'y	1	9
4123-0210-6	Fuse Bracket	1	10
29010-6031-000	Ball	3	A

K&S PART NO.	DESCRIPTION	QUANTITY	ITEM
74970-0632-044 74953-0632-044	Spring Hanger	3	B
64243-2049-108	Extension Spring	2	C
65000-2574-000	Negator Spring	1	F
4123-0211-0	BASE FRAME ASSEMBLY (Fig 3-4,10-1)		
4124-0211-2	Groove Roller	1	3
4124-0211-3	Spacer	2	4
4124-0211-4	Roller	1	5
4123-0210-5	Shoulder Screw	2	A
20647-1118-000	Radial Bearing, flanged	2	B



ROLLER GROOVE ROLLER

FIG 10-1 BASE FRAME - ROLLERS (#4123-0211-0)

K&S PART NO.	DESCRIPTION	QUANTITY	ITEM
4124-0212-0	MANIPULATOR ASSEMBLY (Fig 3-5, 10-2)		
4123-0211-2	Groove Roller	2	-
4123-0211-3	Spacer	2	-
4123-0210-5	Shoulder Screw	2	-
20647-1118-000	Radial Bearing, flanged	2	-
64243-1634-108	Extension Spring	2	-
74970-0632-044	Spring Hanger	2	-
74953-0632-044			
4123-0213-0	FRONT PANEL ASSEMBLY (Fig 3-3, 4-2)		
4123-1210-0	U/S Harness Assembly	1	-
4123-1222-0	Position Harness Assembly	1	-
4123-1230-0	Left Panel Harness Assembly	1	-
4123-0213-2	Front Panel Frame	1	-
4123-0213-3	Right Panel	1	-
4320-0005-7	Skirted Knob	5	-
4123-0213-6	Left Panel	1	-
29030-5515-000	Turns Counting Dial	4	-
25057-6006-000	LIGHT Knob	1	-
11490-6039-001	W.H. Connector, 9 pins	1	-
4123-0214-0	GUIDE ROD RETAINING LEVER ASSEMBLY (Fig 3-4, 3-5)		
4123-0214-2	Lever	1	-
20647-7249-000	Ball Bearing	1	-
4123-0215-0	X-Y FRAME ASSEMBLY (Fig 3-5)		
4123-0215-2	X-Y Frame	1	-
4123-0215-3	Guide Rod (pin)	4	-

K&S PART NO.	DESCRIPTION	QUANTITY	ITEM
4123-0220-0	CHESSMAN ASSEMBLY (Fig 3-6)		
4123-1401-0	Chessman Harness Assembly	1	-
4123-0541-0	Cover	1	-
4123-0220-1	Rod	1	-
4123-0220-2	Motion Limiter	1	-
478-0012-5	CHESSMAN Button	1	-
63543-1622-040	Compression Spring	1	-
12510-6050-003	Connector, 3 pins	1	-
31447-6002-001	STITCH Button	1	-
4123-0350-0	MICROSCOPE HOLDER ASSEMBLY (Fig 3-1)		
4123-0350-2	Bracket	1	-
4123-0350-3	Pin	1	-
2402-5670-0	Arm Assembly	1	-
4124-0400-0	MAIN HEAD ASSEMBLY (Fig 3-10)		
4123-1900-0	Force Actuator Coil Harness Assembly	1	-
4123-0400-1	LVDT Push Rod	1	-
4123-0300-5	Left Cover Bracket (Fig 3-9)	1	-
4123-0300-6	Right Cover Bracket	1	-
4123-0400-3	Link Return Spring	1	-
4124-0400-4	EFO Box Spacer (Fig 3-9)	1	-
25815-6001-000	Air Dashpot (Fig 3-9)	1	-
4124-0410-0	MAIN HEAD BODY ASSEMBLY (Fig 10-3)		
4123-0410-4	Bearing Support	1	2
4123-0410-6	Air Dashpot Support	1	3
4123-0410-8	Tool Lifter Pin	1	4
4123-0410-9	Cam Shaft	1	5
4123-0410-10	Cam Pulley	1	6
4123-0410-12	Cover Pivot	4	7
4124-0410-14	Microscope Support	1	8
4123-0410-15	Bearing Screw Support	1	13

K&S PART NO.	DESCRIPTION	QUANTITY	ITEM
4123-0410-16	Link Pivot	1	14
4123-0410-18	Main Head Frame	1	17
20647-6032-000	Cam Bearing	2	A
4124-0411-0	HEIGHT CONTROL LINK ASSEMBLY (Fig 3-10)		
4123-0411-2	Link	1	-
4123-0411-3	Leveling Screw	1	-
4123-1810-0	Ground Harness Assembly	1	-
478-0555-0	Rod End	1	-
478-5022-4	Rod End Lock Nut	1	-
20647-1053-000	Cam Follower Bearing	1	-
20630-1030-000	Link Bearing	1	-
4123-0421-0	TOOL LIFTER ASSEMBLY (Fig 3-9)		
4123-0710-0	Handle Solder Assembly	1	-
4123-0412-1	Tool Lifter Cam	1	-
4123-0421-3	Bearing	1	-
4123-0413-0	FORCE ACTUATOR ASSEMBLY (Fig 10-4)		
4123-0720-0	Core Assembly	1	2
4123-0413-2	Base	1	4
4123-0413-4	Flange	1	6
4123-0413-6	Support	1	7
4123-0414-0	MAIN/Z LVDT ASSEMBLY (Fig 10-5)		
4123-1500-0	Main LVDT Harness Assembly	1	1
4123-0414-2	LVDT Holder	1	3
4123-0414-4	Bushing	1	5
4124-0420-0	BONDING HEAD ASSEMBLY (Fig 10-6)		
4124-0700-0	Bonding Head Frame Assembly	1	1
4123-0421-2	Air Dashpot Connecting Rod	1	2
4123-0421-8	Front Counterweight Rod	1	3

K&S PART NO.	DESCRIPTION	QUANTITY	ITEM
4123-0421-6	Counterweight	2	4
4124-0770-0	Wire Clamp Assembly	1	7
4124-0420-1	Spacer	1	8
4123-0427-0	Contact Pin Assembly	1	9
4306-0040-0	Gold Wire Ball Bonder Long Horn Transducer	1	10
4124-0420-2	U-Bolt	1	11
20604-1029-000	Angular Contact Flange Bearing	2	C

4123-0440-0 MOTOR-TACHO ASSEMBLY (Fig 10-7)

K&S PART NO.	DESCRIPTION	QUANTITY	ITEM
4123-1600-0	Motor-Tacho Harness Assembly	1	1
4123-0440-1	Pulley	1	2
4123-0440-2	Flange	1	3
4123-0440-3	Damper	1	4

4124-0450-0 EFO ELECTRODE AND DRAG ASSEMBLY (Fig 3-8)

K&S PART NO.	DESCRIPTION	QUANTITY	ITEM
4124-0750-0	Main Bracket Assembly	1	-
4124-0450-0	Electrode Slide	1	-
4124-0450-2	Electrode Height Adjusting Screw	1	-
4124-0450-3	Slide Lock Screw	1	-
4124-1720-0	Drag Solenoid Assembly	1	-
4124-0450-4	Mounting Bracket	1	-
4124-0450-5	Solenoid Tip (Fig 10-8)	1	-

4124-0451-0 EFO SOLENOID BRACKET ASSEMBLY (Fig 10-8)

K&S PART NO.	DESCRIPTION	QUANTITY	ITEM
4124-0451-1	Bracket	1	1
4124-1710-0	EFO Solenoid Assembly	1	2
4124-0450-5	Solenoid Tip	1	3

4124-0452-0 EFO ELECTRODE ASSEMBLY

K&S PART NO.	DESCRIPTION	QUANTITY	ITEM
4124-0780-0	EFO Electrode	1	-
4124-0452-1	Insulator	1	-
4124-0452-2	Leaf Spring	1	-
4124-0452-3	Spring Clamp	1	-

K&S PART NO.	DESCRIPTION	QUANTITY	ITEM
4124-0460-0	SPOOL HOLDER ASSEMBLY (Fig 10-9)		
4124-0460-1	Spool Holder Support	1	1
4124-0461-0	Kicker Assembly	1	2
4124-1730-0	Kicker Solenoid Assembly	1	3
1418-0010-8	Spool Holder	1	4
1418-0010-7	Spool Cap	1	5
478-5020-16	Tensioner Bracket	1	6
478-5020-9	Glass Plate	1	7
475-5020-39	Spool Dust Cover	1	8
475-5020-51	Glass Feed Tube	1	9
478-0564-0	Leaf Spring Assembly	1	10
478-0910-23	Ground Plate	1	11
4124-0460-2	Kicker Pivot	1	12
4124-0460-3	Extension Spring	1	13
4124-0462-0	Kicker Clamping Screw Assembly	1	14
4124-0450-5	Solenoid Tip (Fig 10-8)	1	15
4124-0461-0	KICKER ASSEMBLY (Fig 3-12)		
4124-0461-1	Pivot Housing	1	-
4124-0785-0	Kicker Link Assembly	1	-
4123-0510-0	BASE BODY ASSEMBLY (Fig 3-4)		
478-5001-10	Ball Retainer	3	-
484-0001-14	Ball Raceway	3	-
4123-0510-2	Base	1	-
20676-1251-000	Spherical Bearing	1	-
4123-0520-0	MANIPULATOR BODY ASSEMBLY (Fig 3-5)		
4123-0520-2	Manipulator	1	-
478-5001-10	Ball Retainer	3	-
484-0001-14	Ball Raceway	3	-
20676-1251-000	Spherical Bearing	1	-

K&S PART NO.	DESCRIPTION	QUANTITY	ITEM
4123-0530-0	CHESSMAN BODY ASSEMBLY (Fig 3-6)		
4123-0530-2	Chessman Housing	1	-
20675-1251-000	Spherical Bearing	1	-
60804-0332-340	O-Ring	1	-
4124-0750-0	MAIN BRACKET ASSEMBLY (Fig 3-8)		
4124-0750-1	Main Bracket	1	-
4124-0751-0	Drag Clamp Leaf Spring Assembly	1	-
478-0563-2	Drag Clamp Wire Guide	2	-
4124-0750-6	Drag Spring Clamp	1	-
4123-0770-5	Drag Force Spring	1	-
4124-0750-4	Drag Force Adjusting Nut	1	-
4124-0860-7	Drag Force Spring Shoe	1	-
29042-2440-000	Drag Clamp Jewel	1	-
4123-0810-0	SPOTLIGHT CONE ASSEMBLY (Fig 3-2, 6-5)		
4123-0810-2	Spotlight Cone	1	-
478-5019-5	Spotlight Tilt Pivot	1	-
4123-1210-0	U/S HARNESS ASSEMBLY		
56117-7500-008	TIME Potentiometer 50 kOhm, 10%, 2 W, lin.	2	-
56095-7100-008	POWER Potentiometer 10 kOhm, 5%, 10 turns, lin.	2	-
55120-6003-000	U/S Red LED 1.5 mA	1	-
12510-6051-010	Connector, 10 pins	1	-
11551-1000-000	Contact Pin	9	-
4123-1220-0	POSITION HARNESS ASSEMBLY		
55120-6003-000	1ST, 2ND, Red LED 1.5 mA	2	-
56116-6100-008	FORCE, LOOP Potentiometer 1 kOhm, 10%, 2 W, 1 turn, lin.	3	-
59095-6100-008	SEARCH Potentiometer 1 kOhm, 10 turns	2	-
12510-6050-015	Connector, 15 pins	1	-
11551-1000-000	Contact Pin	14	-

K&S PART NO.	DESCRIPTION	QUANTITY	ITEM
4123-1230-0	LEFT PANEL HARNESS ASSEMBLY		
15878-6001-000	SET-UP/RESET Toggle Switch	1	-
15878-0386-000	CLAMP, MOTOR Toggle Switch	2	-
15878-6002-000	TEST Toggle Switch	1	-
12510-6050-000	Connector, 8 pins	1	-
11551-1000-000	Contact Pin	8	-
4123-1301-0	MOTHER BOARD ASSEMBLY (100 Vac) (Fig 3-15)		
4123-4200-0	Transformer Assembly	1	-
4123-1321-0	Main Harness Assembly (100 Vac)	1	-
4123-4311-0	PC Board Assembly (100 Vac)	1	-
4123-1302-0	MOTHER BOARD ASSEMBLY (120 Vac)		
4123-4200-0	Transformer Assembly	1	-
4123-1322-0	Main Harness Assembly (120 Vac)	1	-
4123-4312-0	PC Board Assembly (120 Vac)	1	-
4123-1303-0	MOTHER BOARD ASSEMBLY (220 Vac)		
4123-4200-0	Transformer Assembly	1	-
4123-1323-0	Main Harness Assembly (220 Vac)	1	-
4123-4313-0	PC Board Assembly (220 Vac)	1	-
4123-1304-0	MOTHER BOARD ASSEMBLY (240 Vac)		
4123-4200-0	Transformer Assembly	1	-
4123-1324-0	Main Harness Assembly (240 Vac)	1	-
4123-4314-0	PC Board Assembly (240 Vac)	1	-
4123-1321-0	MAIN HARNESS ASSEMBLY (100 Vac) (Fig 10-10)		
56030-7470-001	LIGHT Switch-Potentiometer	1	2
12510-6050-003	Connector, 3 pins	1	D
18539-6008-000	Fuse Holder	2	T
15878-8000-000	POWER Switch	1	U
18538-6041-000	Fuse, 1 A sb F1	1	V

K&S PART NO.	DESCRIPTION	QUANTITY	ITEM
18538-6037-000	Fuse, 3 A sb F2	1	W
11551-1000-000	Contact Pin	3	X
16575-6029-000	Fork Tongue Terminal	2	Y
16575-6031-000	Fork Tongue Terminal	5	Z
11550-6007-000	Contact Pin	5	AI

4123-1322-0 MAIN HARNESS ASSEMBLY (120 Vac)

Identical with 4123-1321-0 Harness (100 Vac)

4123-1323-0 MAIN HARNESS ASSEMBLY (220 Vac)

Identical with 4123-1321-0 Harness (100 Vac), except:

18538-6049-000	Fuse, 0.5 A sb F1	1	V
18538-6045-000	Fuse, 2.5 A sb F2	1	W

4123-1324-0 MAIN HARNESS ASSEMBLY (240 Vac)

Identical with 4123-1323-0 Harness (220 Vac)

4123-1401-0 CHESSMAN HARNESS ASSEMBLY (Fig 3-6)

488-1000-6	CHESSMAN Switch	1	-
15850-6027-000	STITCH Switch	1	-
11551-1000-000	Contact Pin	3	-

4123-1500-0 MAIN/Z LVDT HARNESS ASSEMBLY

12510-6050-006	Connector, 3 pins	1	-
16910-6001-000	LVDT	1	-
11551-1000-000	Contact Pin (of 3-pin connector)	6	-

4123-1510-0 PHOTOCELL (OPTOCOUPLER) HARNESS ASS'Y (Fig 3-11, 3-15)

4534-0016-1	PC Board	1	-
54160-0029-290	Photocell	1	-
12510-6051-003	Connector, 3 pins	1	-
11551-1000-000	Contact Pin	3	-

K&S PART NO.	DESCRIPTION	QUANTITY	ITEM
4124-2000-0	EFO ASSEMBLY (Fig 3-13)		
4124-4400-2	EFO Board Assembly	1	-
4124-2000-1	EFO Box (Chassis)	1	-
4124-2000-2	EFO Cover	1	-
4124-4100-0	LOGIC BOARD ASSEMBLY (Fig 10-11, 11-8)		
4124-4100-1	PC Board	1	1
4305-1001-0	Output Transformer Assembly	1	2
4123-4100-4	Heat Sink	2	3
18538-6072-000	Fuse, 0.63A sb	1	DO
13874-4115-000	U/S Jack	1	DP
15878-6032-000	U/S POWER HIGH/LOW Switch	1	DQ
13874-6000-001	Suppressor Diode	2	DR
13874-6000-002	Suppressor Diode	1	DS
18539-6013-000	Fuse Clip	2	DU
4123-4311-0	MOTHER BOARD PC ASSEMBLY (100 Vac) (Fig 10-12)		
4123-4310-1	PC Board	1	1
4123-4100-4	Heat Sink	1	2
55185-6001-291	Varistor, 50 V RV2	1	N
55185-6001-292	Varistor, 130 V RV1	1	O
18538-6055-000	Fuse, 1 A sb F3, F4	2	P
18538-6065-000	Fuse, 2.5 A sb F6	1	Q
18538-6059-000	Fuse, 1.25 A sb F5	1	R
11440-5331-000	Connector, 3 pins	1	AA
11440-6019-000	Connector, 2 pins	1	AB
11551-1000-000	Contact Pin	5	AD
12510-6050-005	Connector, 5 pins	1	AE
4123-4312-0	MOTHER BOARD PC ASSEMBLY (120 Vac)		

Identical with 4123-4311-0 Board Assembly (100 Vac)

K&S PART NO.	DESCRIPTION	QUANTITY	ITEM
4123-4313-0	MOTHER BOARD PC ASSEMBLY (220 Vac)		
	Identical with 4123-4311-0 Board Assembly (100 Vac), except:		
55185-6001-294	Varistor, 250 V RV1	1	0
4123-4314-0	MOTHER BOARD PC ASSEMBLY (240 Vac)		
	Identical with 4123-4313-0 Board Assembly (220 Vac)		
4124-4400-0	EFO BOARD ASSEMBLY (Fig 10-13)		
4124-4400-1	EFO Board	1	1
4123-1720-1	Connector	1	3
4124-4400-4	EFO Line Transformer	1	5
4124-4410-0	Ball Size Adjuster Selector Assembly	1	6
4124-4420-0	EFO Switches Harness Assembly	1	7
55185-0130-290	Varistor 130 V	1	R
55185-6001-299	Varistor 480 V	1	S
14990-6000-000	Mercury Wetted Relay	1	T
18538-6073-000	Fuse, 100 mA sb	1	U
18539-6013-000	Fuse Clip	2	V
16561-6012-000	Terminal Receptacle	1	AB
11551-1000-000	Contact Pin	2	AC
16582-6011-000	Split Lug Terminal	2	AF
15878-6045-000	EFO RANGE HIGH/LOW Switch	1	AG
16575-6029-000	Fork Tongue Terminal	1	AH
4124-4420-0	EFO SWITCHES HARNESS ASSEMBLY		
4124-4420-1	Bracket	1	2
15878-0378-000	POWER/OFF Toggle Switch	1	A
15850-6027-000	EFO Red Pushbutton	1	B
12974-6001-000	POWER Neon Indicator 115 V, 30 K, red	1	E
4123-7200-0	MANUAL Z ASSEMBLY (Fig 3-11, 10-5)		
4123-1500-0	Z-LVDT Harness Assembly	1	
4123-0414-2	LVDT Holder	1	
4123-0414-4	LVDT Bushing	1	

K&S PART NO.	DESCRIPTION	QUANTITY	ITEM
4123-7200-2	Z-Lever	1	
4123-7200-4	Lever	1	
4123-7200-5	Axle	1	
4123-7200-6	Axle Support	1	
4123-7200-7	Push Rod	1	
4123-7200-8	Photocell (optocoupler) Flag	1	
4123-7200-9	LVDT Core Pin	1	
478-0555-0	Rod End Assembly	1	
478-5022-4	Rod End Lock Nut	1	
4123-7200-11	Finger Tab	1	
4123-1510-0	Photocell Harness Assembly	1	
4123-7200-10	Torsion Spring	1	
4123-7200-12	Extension Spring	1	
20647-1118-000	Flange Bearing	4	

<u>4123-7300-0</u> <u>SPOTLIGHT ASSEMBLY</u> (Fig 3-2, 6-5)

478-5019-4	Retaining Spring	1	
525-0001-3	Centering Screw (tack)	2	
525-0001-2	Screw Pad (tip)	2	
478-0567-0	Focusing Ring	1	
478-0568-0	Tube	1	
4123-1840-0	Spotlight Harness Assembly	1	
4123-7300-0	Mount	1	

10.2 SPARE PARTS KIT 4124-0900-0

10.2.1 MECHANICAL

K&S PART NO.	DESCRIPTION	QUANTITY
4123-0410-10	Cam Pulley	1
4123-0427-0	Contact Pin Assembly	1
4124-0770-0	Wire Clamp Assembly	1
4123-1100-0	Wire Clamp Solenoid Assembly	1
4123-1500-0	LVDT Harness Assembly	1
4123-1600-0	Motor-Tacho Harness Assembly	1
4124-1710-0	EFO Solenoid Assembly	1
4124-1720-0	Drag Solenoid Assembly	1
4124-1730-0	Kicker Solenoid Assembly	1
4123-1900-0	Force Actuator Coil Harness Assembly	1
478-5019-4	Spotlight Holder Spring	1
488-1000-6	CHESSMAN BUTTON Switch	1
4124-0751-0	Drag Clamp Leaf Spring Assembly	1
4124-0452-0	EFO Electrode Assembly	1
4123-0770-5	Clamp Force Spring	1
1418-0010-7	Spool Cap	1
478-5020-16	Fixed Tensioner Bracket	1
478-5020-9	Fixed Tensioner Glass Plate	2
478-0011-51	Spool Holder Glass Feed Tube	2
4124-0460-3	Kicker Extension Spring	1
4124-6000-2	Capillary Insertion (setup) Gauge	1
4124-0450-5	Solenoid Tip	1
29010-6031-000	Manipulator Support Ball	3
60508-0224-240	Drive Belt O-Ring	1

10.2.2 ELECTRICAL AND ELECTRONIC

K&S PART NO.	DESCRIPTION	QUANTITY
18538-6065-000	Fuse, 2.5A sb type T mini	2
18538-6055-000	Fuse, 1A sb type T mini	4
18538-6059-000	Fuse, 1.25A sb	2
18538-6073-000	Fuse, 100 mA sb type T mini	2
18538-6072-000	Fuse, 0.63A sb type T mini	2
18538-6041-000	Fuse, 1A sb, 100-120V power	2
18538-6037-000	Fuse, 3A sb, 100-120V power	2
18538-6049-000	Fuse, 0.5A sb, 220-240V power	2
18538-6045-000	Fuse, 2.5A sb, 220-240V power	2
12918-1421-000	Area Light Lamp	2
12933-5424-000	Spotlight	2
55160-6000-000	Diode 1N4002	2
56640-3300-380	Transistor MJE 3300	1
56640-3310-380	Transistor MJE 3310	1
53560-1741-380	I.C. MC1741	1
52660-4016-380	I.C. MC14016	1
52661-4538-990	I.C. MC14538	1
52660-4027-990	I.C. MC14027	1
52660-4011-991	I.C. MC14011	1
52660-4049-991	I.C. MC14049	1
52660-4023-991	I.C. MC14023	1
52660-4001-991	I.C. MC14001	1
53560-1416-380	I.C. MC1416	1
52662-0308-000	I.C. DG308	1
52661-4093-380	I.C. MC14093	1
54160-0426-380	I.C. 4N26	1
54590-7815-380	Vol. Reg. MC7815	1
54590-7915-380	Vol. Reg. MC7915	1
54590-7808-380	Vol. Reg. MC7808	1
12974-6001-000	EFO POWER Neon Indicator	1
55124-5569-000	Red LED (logic board & right panel)	3

10.2.2 ELECTRICAL AND ELECTRONIC (Continued)

K&S PART NO.	DESCRIPTION	QUANTITY
56640-6008-001	Transistor Tip 116 or Tip 117	1
56640-6008-002	Transistor Tip 116 or Tip 117	1
56680-4256-000	Triac	1
18538-6071-000-0	Fuse 4A	2
55185-6001-297	Varistor	

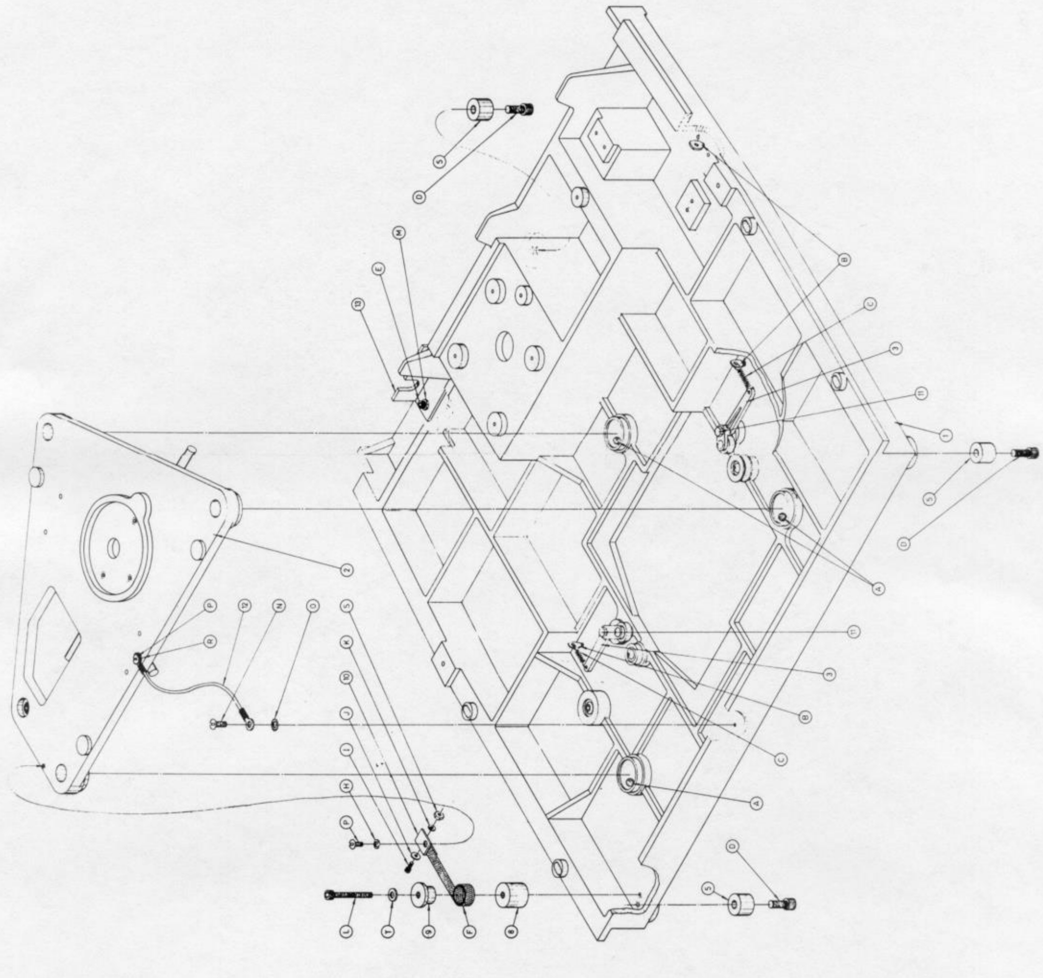


FIG. 10-2 MECHANICAL BASE ASSEMBLY (#4124-0210-0)

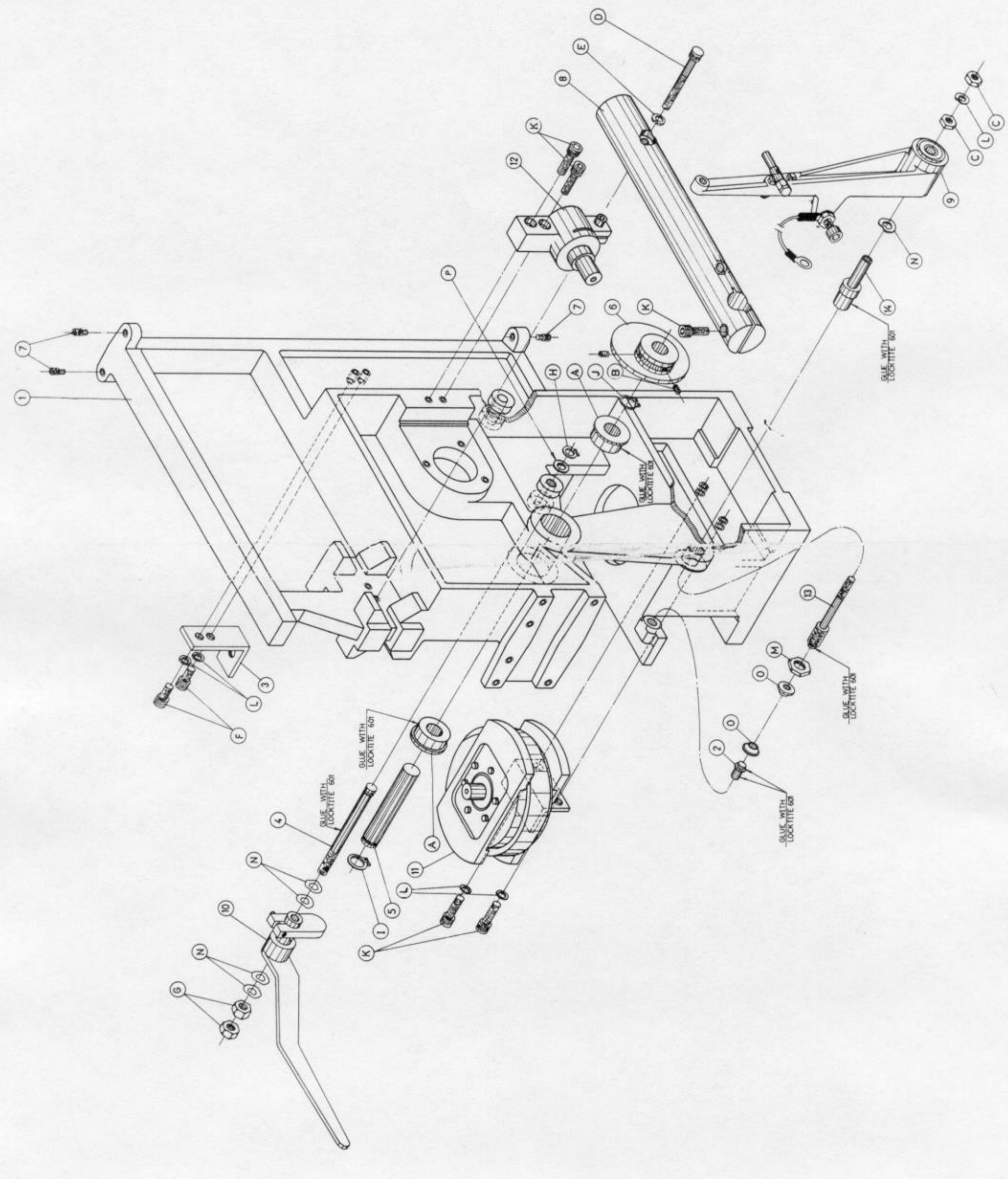


FIG. 10-3 MAIN HEAD BODY ASSEMBLY (#4124-0410-0)

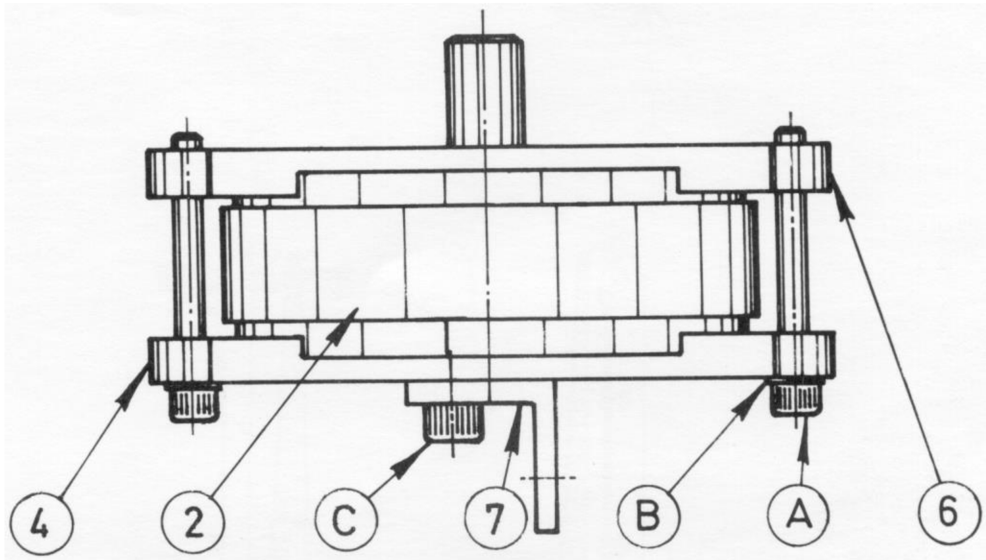


FIG. 10-4 FORCE ACTUATOR ASSEMBLY (#4123-0413-0)

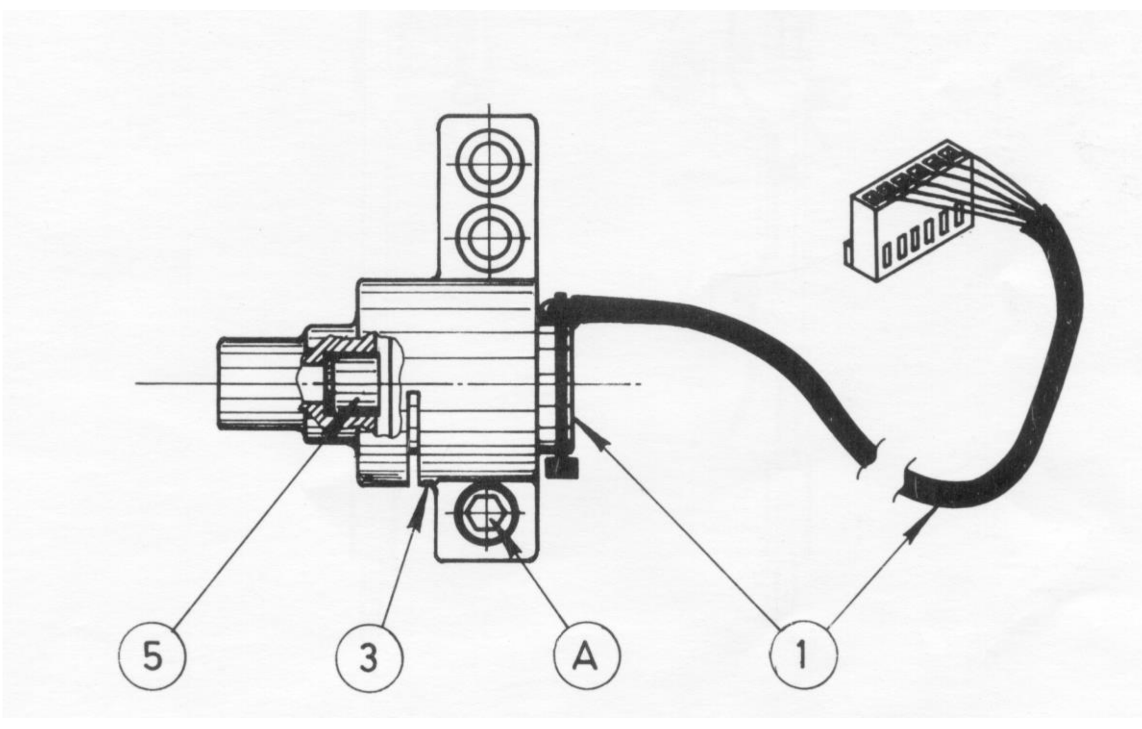


FIG. 10-8 MAIN/Z LVDT ASSEMBLY (#4123-0414-0)

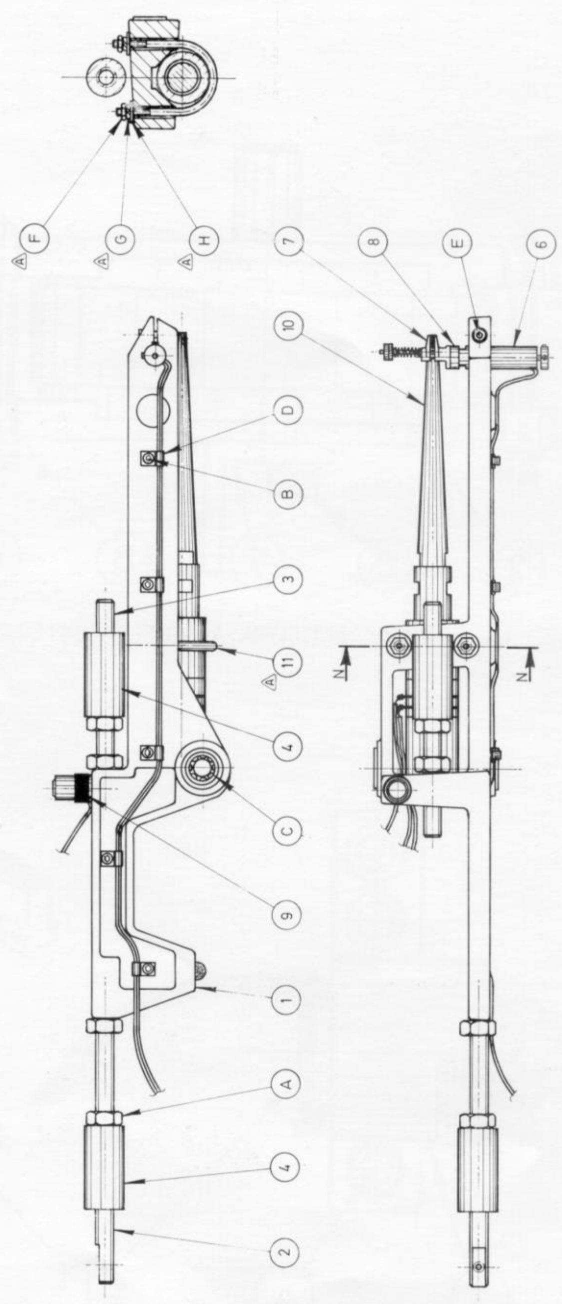


FIG. 10-6 BONDING HEAD ASSEMBLY (#4124-0420-0)

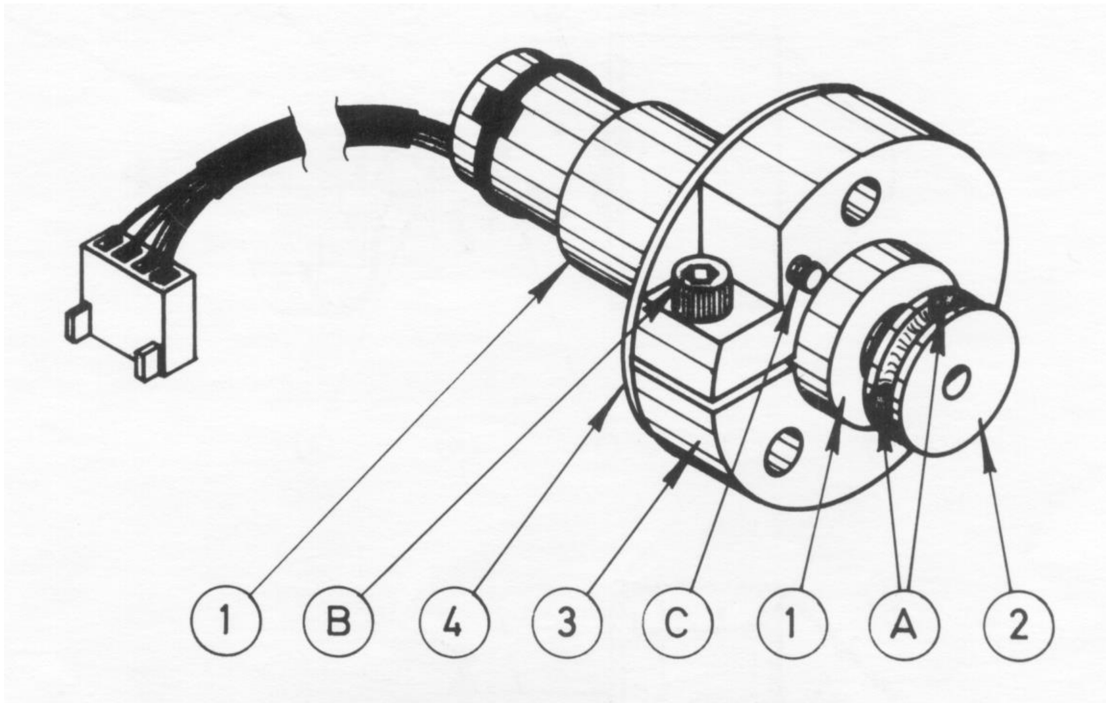


FIG. 10-7 MOTOR-TACHO ASSEMBLY (34123-0440-0

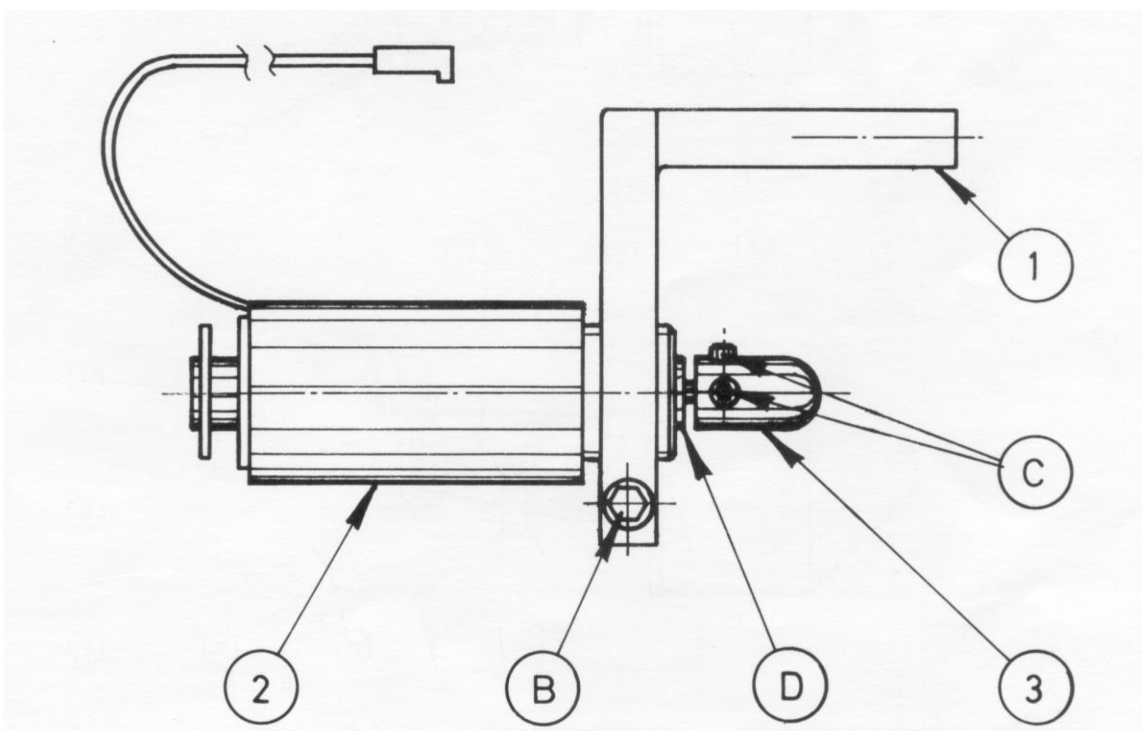


FIG. 10-8 EFO SOLENOID BRACKET ASSEMBLY (#4124-0451-0)

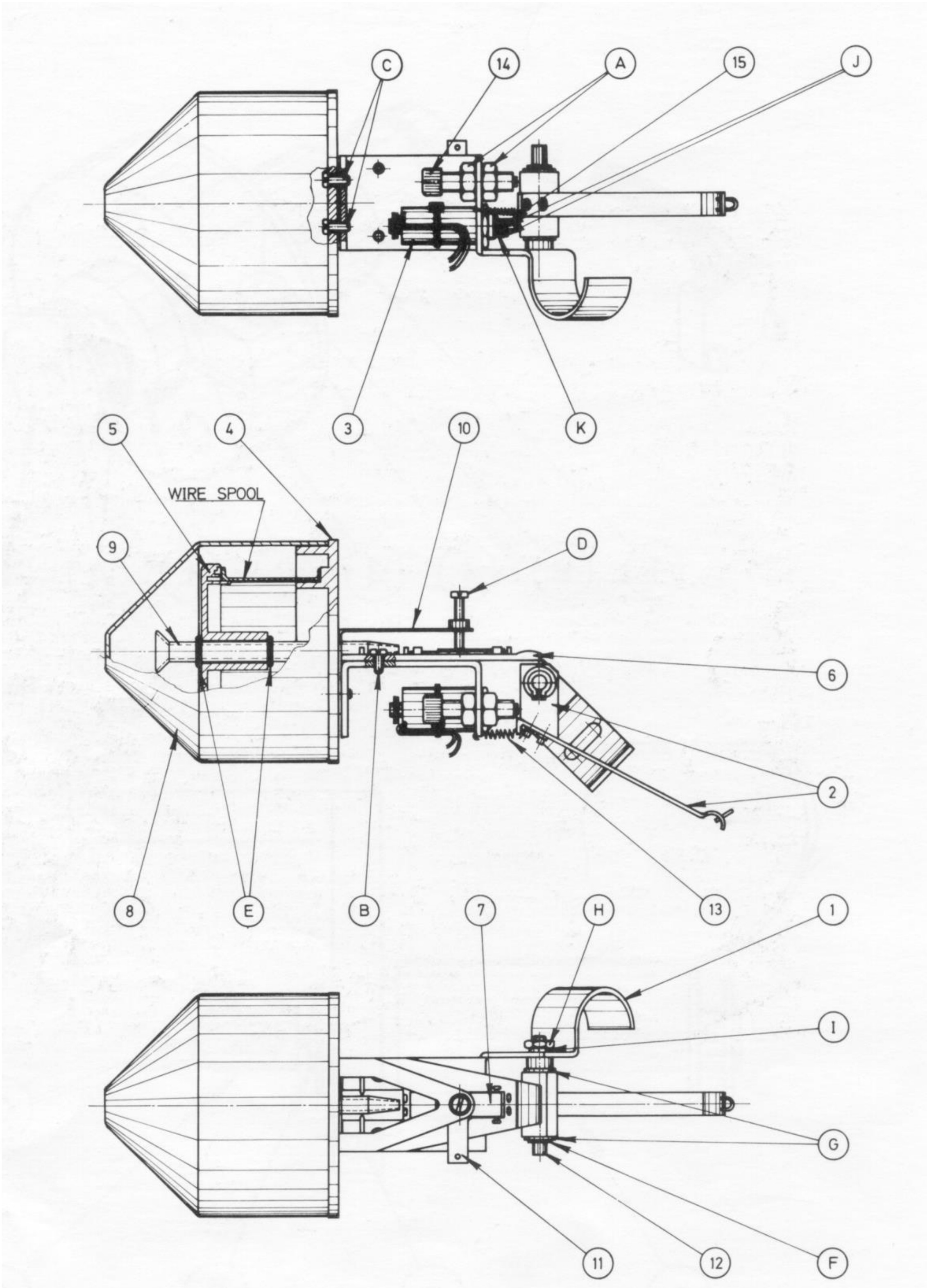


FIG 10-9 SPOOL HOLDER ASSEMBLY (#4124-0460-0)

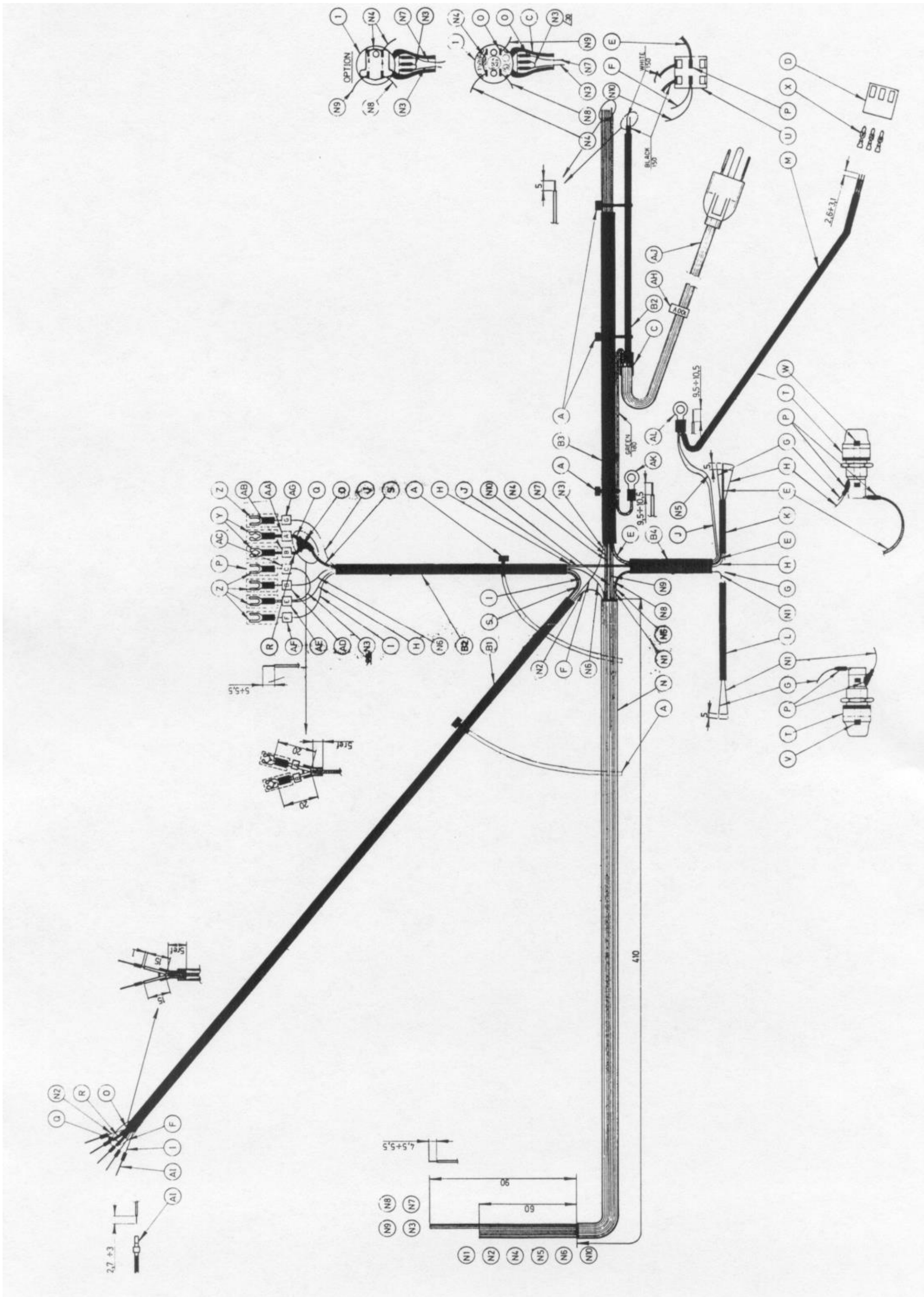


FIG. 10-10 MAIN HARNESS ASSEMBLY (#4123-1321-0)

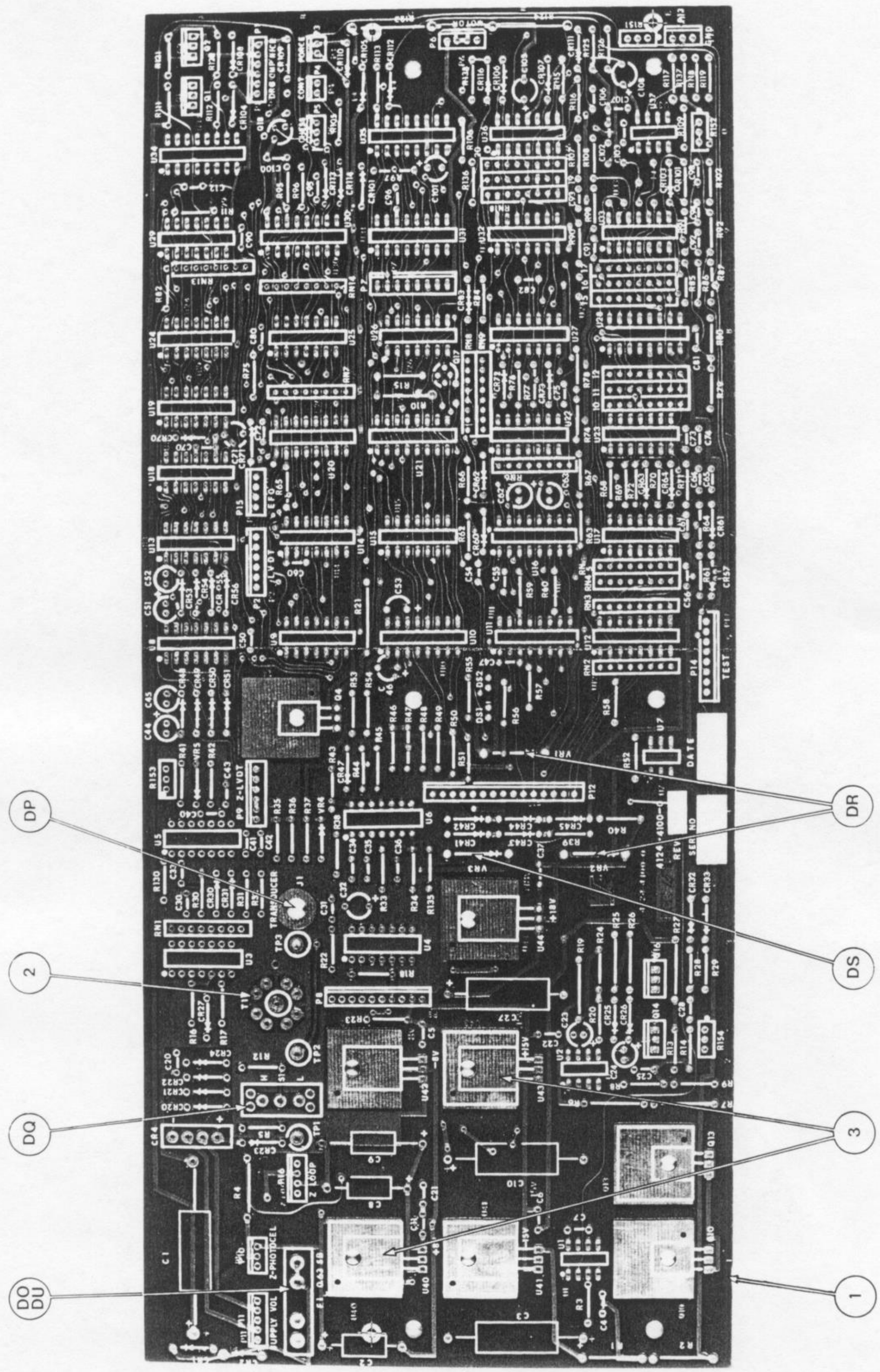


FIG. 10-11 LOGIC BOARD - COMPONENTS LAYOUT (#4124-4100-0)

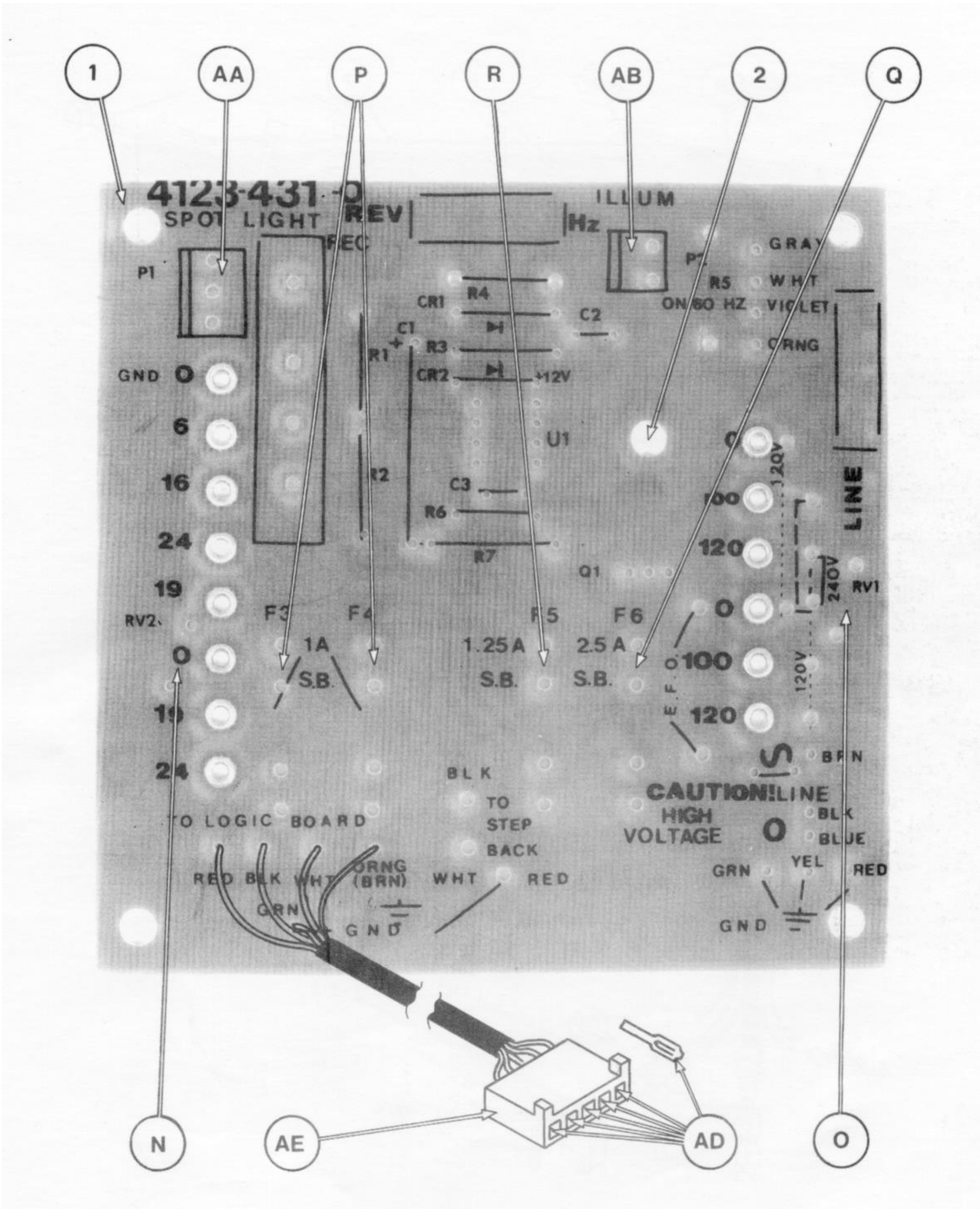


FIG 10-12 MOTHER BOARD - COMPONENTS LAYOUT (#4123-4311-0)

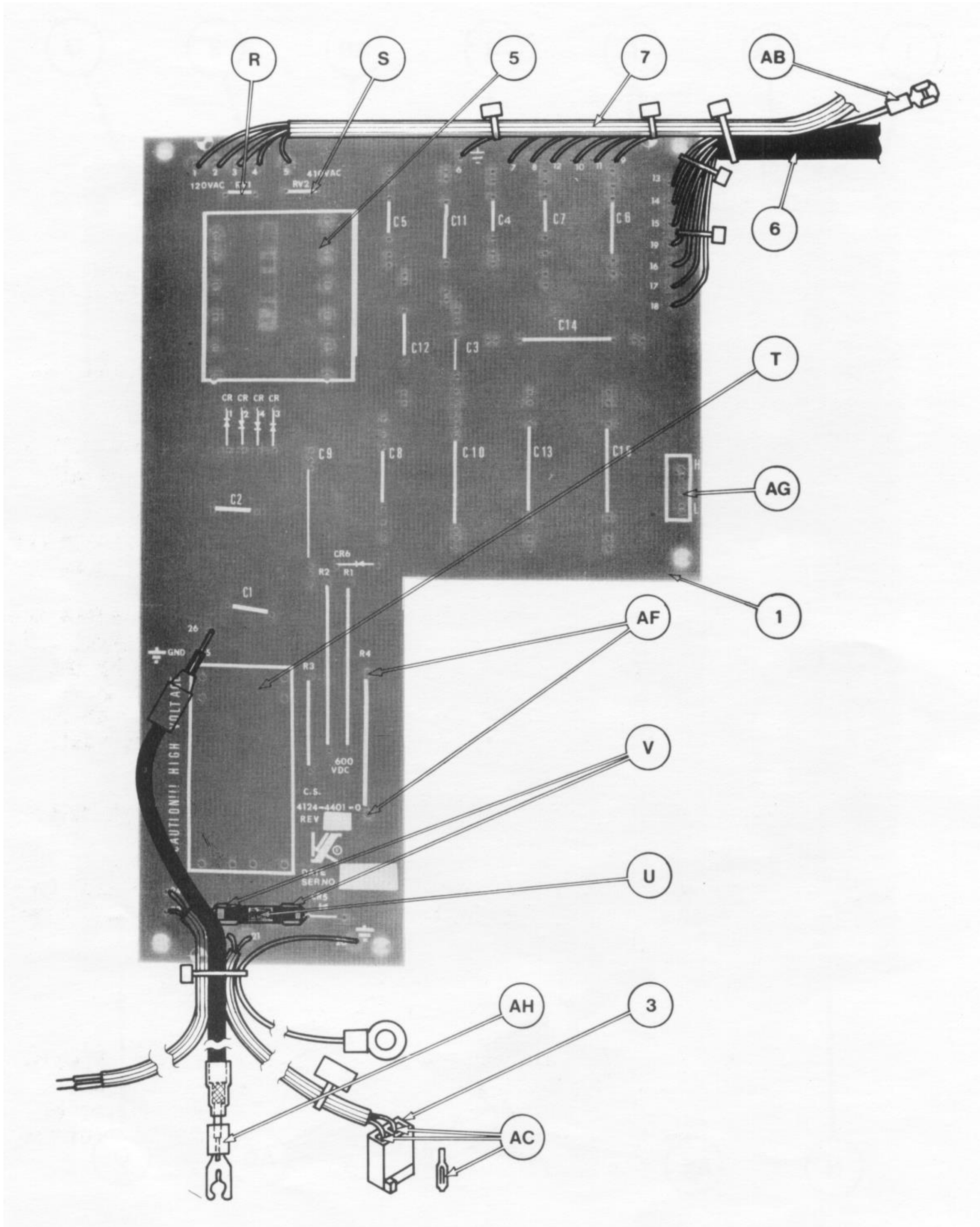


FIG. 10-13 EFO BOARD - COMPONENTS LAYOUT (#4124-4400-0)

11.1 GENERAL DESCRIPTION

11.1.1 FUNCTIONAL DESCRIPTION

The electronic control system of the Model 4124 Ball Bonder has the following functions (Fig 11-1):

11.1.1.1 LOGIC utilizes input signals to schedule events in the bonding cycle and to trigger the driving of machine mechanisms accordingly.

11.1.1.2 EXCITATION OSCILLATOR powers the main LVDT and the Z-LVDT coils.

11.1.1.3 POSITION MULTIPLEXER is a set of 5 reference voltages corresponding to vertical position of the bonding capillary.

RESET and OVERTRAVEL are fixed. LOOP, 1st SEARCH and 2nd SEARCH are adjustable by dial potentiometers.

11.1.1.4 POSITION DETECTOR is a comparator that measures the voltage difference between the MAIN LVDT output and the relevant reference voltage as selected by the logic from the POSITION MULTIPLEXER. When this difference reaches zero, a signal is sent from the POSITION DETECTOR to the logic to start the next phase in the bonding cycle.

11.1.1.5 SERVO MOTOR POWER AMPLIFIER drives the servo motor from the summing-point output signal.

11.1.1.6 POSITION FEEDBACK AMPLIFIER feeds position data to the position detector and summing point from the main LVDT.

11.1.1.7 SPEED FEEDBACK AMPLIFIER feeds speed data to the summing point from the tachometer.

11.1.1.8 MODE CIRCUIT switches the system over from chessman to manual Z mode on a signal from the Z-photocell (optocoupler) system. Also returns the system to chessman mode immediately after 2nd bond to insure proper tail and ball size.

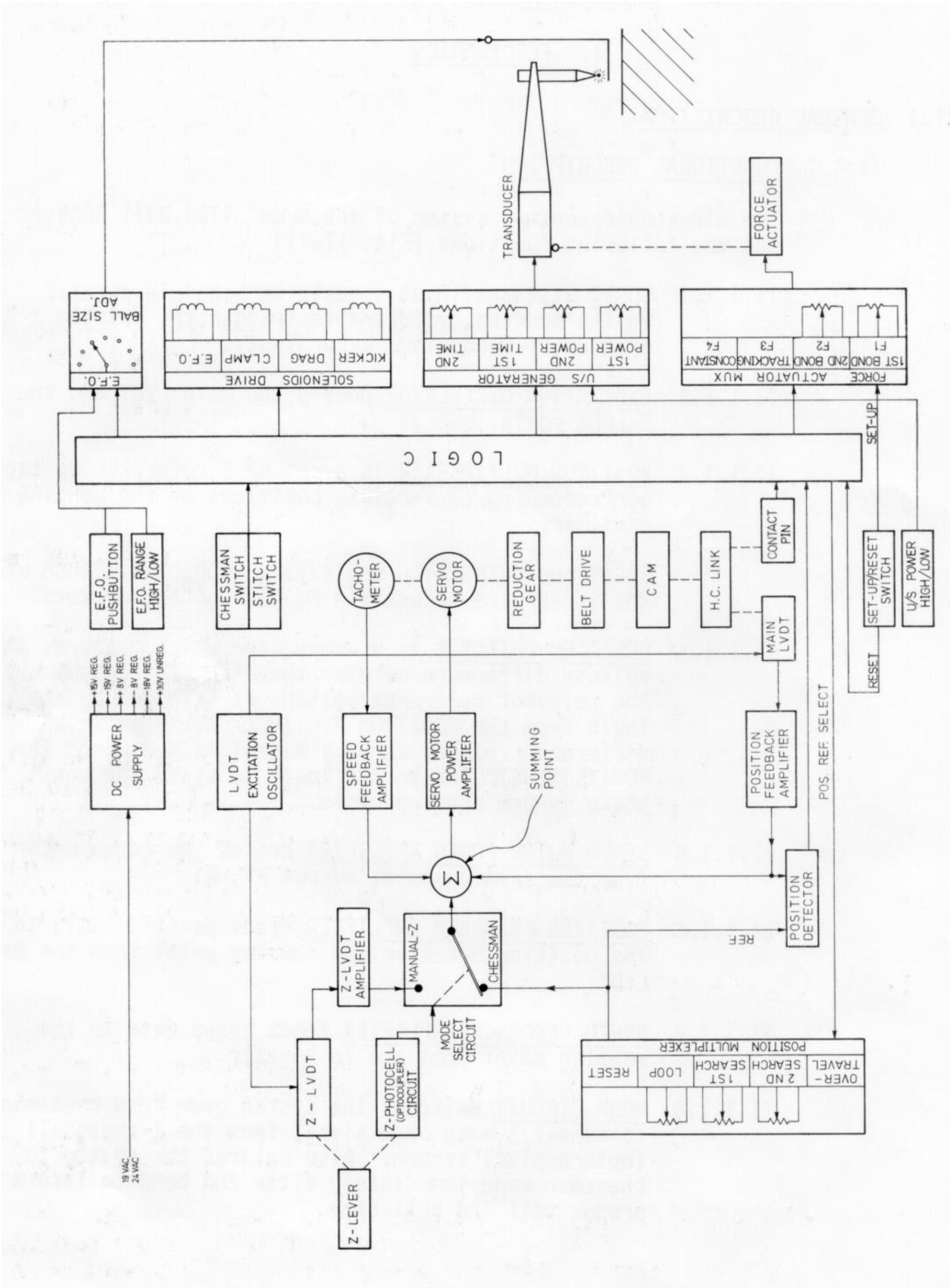


FIG. 11-1 ELECTRONIC CONTROL SYSTEM - BLOCK DIAGRAM

11.1.1.9 CONTACT PIN CIRCUIT enables the release of the wire clamp solenoid after the 2nd bond when the leveling screw on the height control link restores contact with the contact pin on the bonding head. A small time-delay is inserted before solenoid release for securing proper tail and ball size, regardless of 2nd bond height.

11.1.1.10 ULTRASONIC GENERATOR is a PLL-based built-in circuit that provides the electrical output for the transducer at its own resonant frequency of the moment.

11.1.1.11 FORCE ACTUATOR DRIVE supplies DC current in four levels to the force actuator. The logic selects the force from three reference voltages stored in the force actuator multiplexer. As long as none of these reference voltages has been selected, current for Constant force is applied.

11.1.1.12 SOLENOIDS DRIVE CIRCUIT powers all four solenoids in response to signals from the logic.

11.1.1.13 Z-LVDT AMPLIFIER receives the output of the Z-LVDT and controls the servo motor in manual Z mode.

11.1.1.14 EFO CIRCUIT is a power supply that charges any of 12 different capacitors, selected by BALL SIZE ADJ., with 1200 Vdc for determination of ball dimensions. It sparks off EFO electrode when brought close to the capillary.

11.1.1.15 EFO RANGE HIGH/LOW switch on the EFO board in the main head selects wide EFO power range. The EFO red pushbutton on the EFO panel triggers a constant 1200 Vdc charge on the electrode, as long as pressing continues, to secure manual ball formation when tilting the electrode towards the capillary by hand. As a ball is made, the gap increases and together with capacitors, discharge in the EFO circuit extinguishes the spark.

11.1.2 OPERATOR INPUTS TO LOGIC

11.1.2.1 SET-UP/RESET SWITCH (Fig 4-1): SET-UP is used to apply bond forces on capillary during parameters adjustment. RESET returns the cycle to the starting point.

11.1.2.2 U/S POWER HIGH/LOW SWITCH (Fig 4-3, 11-8) selects wide ultrasonic power range. It is located on the logic board.

11.1.2.3 CHESSMAN SWITCH, when operated, starts the servo motor from RESET or LOOP position, which then keeps running until stopped at the next SEARCH position. Releasing the button restarts the servo motor. The machine automatically makes a bond and completes its half-cycle, ending at LOOP after the 1st bond or at RESET after the 2nd bond.

11.1.2.4 Z-SYSTEM upon lowering Z-lever has the following two effects:

1) The Z-flag exposes the Z-photocell, which switches the mode circuit over to manual Z mode. The output of the Z-LVDT replaces the position multiplexer as a reference voltage for the feedback control loops.

2) The Z-lever, through the Z-LVDT, unbalances the equilibrium at the position detector and alerts the logic to start the servo motor. The imbalance at the summing point drives the servo motor to track the Z-LVDT, causing the bonding head to follow the Z-lever downwards.

At appropriate points in the cycle, the logic turns the four solenoids on and off to manage wire feed, tear and EFO operation.

When the capillary is stopped in its down motion by the bonding surface, contact is broken between the leveling screw on the height control link and the contact-pin on the bonding head. The cam continues to turn, tilting forward the height control link and withdrawing the core further from the main LVDT. When the position detector senses that the core has arrived at “overtravel” (the equivalent of bonding head OVERTRAVEL), this position causes the logic to operate the ultrasonic generator and the force actuator at the 1st and 2nd bonds’ dial settings, respectively.

Raising the Z-lever changes the output of the Z-LVDT in the opposite direction, causing the servo motor to reverse. The resulting back-tilt of the height control link raises the bonding head. If the Z-lever is released entirely, the bonding head rises all the way to RESET. The operator can limit LOOP height manually by not allowing the Z-lever to rise all the way after the 1st bond.

11.1.2.5 STITCH SWITCH when depressed after the 2nd bond, keeps the clamp solenoid energized (clamp open). Operation of the Z-lever or the CHESSMAN button makes successive stitch-bonds at the 2nd bond dial settings, as long as the STITCH button is held in. When finally released, the logic switches over once again to chessman mode for completing the cycle, including tail formation, EFO and return to RESET.

11.1.3 ELECTRONIC SYSTEM FUNCTIONS

The electronic functions include the following: synchronization; vertical position control; servo motor control; operation of solenoids; operation of force actuator; delivery of ultrasonic pulses to the bond; EFO triggering.

11.1.3.1 SYNCHRONIZATION means sequencing of cycle phases so that they occur in a given order at fixed positions if the core of the main LVDT. These points are: RESET, 1st SEARCH, LOOP 2nd SEARCH, OVERTRAVEL. Each point corresponds to a certain vertical position of the bonding head. On the logic board each of the vertical positions is represented by a reference voltage stored in the position multiplexer. The 1st SEARCH, LOOP and 2nd SEARCH are adjustable by dial potentiometers, while RESET and OVERTRAVEL are fixed.

Vertical position signals are generated in the position detector by comparing the variable output of the main LVDT against a reference voltage selected by the logic from the position multiplexer. Since the main LVDT output voltage is proportional to the displacement of its core, the output of the position detector tells how close the cam is to the required position. Whenever the position detector output is zero, this means that the cam has arrived at the next stage in the cycle. The logic uses zero-volt arrival signals to schedule (sequence commands) to the force actuator, the ultrasonic generator and the solenoids drive circuit, and to determine the next destination from the reference voltages in the position multiplexer.

In manual Z mode, the Z-LVDT takes the place of the position multiplexer. Since Z-LVDT output continually follows the position of the Z-lever, there are no fixed reference voltages, except for the extremes RESET and OVERTRAVEL. These two are determined by stop screws that set mechanical limits on the travel of the Z-lever and LVDT core.

11.1.3.2 VERTICAL POSITION CONTROL of the bonding head includes speed control as well, both accomplished by the position loop and speed loop respectively. These two loops have in common the summing point, the power amplifier and the servo motor.

The position loop includes the following: position multiplexer, summing point, power amplifier, servo motor, reduction gear and belt drive, height control link, main LVDT, and position feedback amplifier.

The speed loop includes the following: summing point, power amplifier, servo motor, tachometer, and speed feedback amplifier.

The tachometer on the servo motor shaft is essentially a miniature DC generator whose output voltage is proportional to the motor speed. The tachometer feedback at the summing point rises as the motor picks up speed. It opposes the driving voltage and causes the motor to accelerate and decelerate gradually, keeping the speed within limits.

11.1.3.3 CHESSMAN MODE OPERATION: The summing point receives three voltage inputs: reference from the position multiplexer, feedback from the main LVDT, and feedback from the tachometer. The motor is driven by the resultant voltage at the summing point, at a speed related to this voltage. As the bonding head nears its destination, the main LVDT feedback voltage approaches the reference voltage, reducing the output from the summing point and slowing down the motor until it stops at its destination smoothly and evenly.

In the speed loop, feedback voltage from the tachometer increases as the motor picks up speed. The net effect is to modulate the speed of the bonding head and to prevent overshoot (together with the air dashpot mechanism).

11.1.3.4 MANUAL Z OPERATION: The variable output of the Z-LVDT replaces the three adjustable reference voltages in the position multiplexer as input to the summing point. Bonding head motion and speed are now governed manually by the Z-lever, but modulated by the feedback loops (together with the air dashpot).

11.1.4 OUTPUTS FROM LOGIC

Logic outputs include the following:

- Signals for selection of position multiplexer reference voltages corresponding to LVDT positions.
- Signals for operation of the ultrasonic generator.
- Signals for selecting 1^{st} bond and 2^{nd} bond parameters.
- Signals for selecting and triggering force actuator currents (forces) from reference voltages in the actuator multiplexer.
- Signals for scheduling (sequencing) and operating solenoids.
- Signals for initiating EFO generation in the EFO circuit.

11.2 LOGIC BOARD CIRCUIT DESCRIPTION

11.2.1 DC POWER SUPPLY

This circuit is based on 5 voltage regulators: U40-U43 (Fig 11-2) and the additional U44 (Fig 11-3).

The circuit supplies +15V and –15V for all IC’s; +8V and –8V for the reference inputs of the position detector and the force actuator; +18V for the U/S power amplifier; and unregulated +30V for solenoids drive. U40-U43 are fed from a full-wave rectifier, protected by input diodes, and filtered in the inputs and outputs by capacitors. Suppressor diodes VR1-VR3 protect the +15V, -15V and +18V outputs against transients.

11.2.2 LVDT EXCITATION OSCILLATOR

This circuit is based on operational amplifier U2 (Fig 11-2) with transistors Q14 and Q16.

The circuit generates 18V ptp at 2.5 kHz for the main LVDT and the Z-LVDT. This is a Wien-bridge R-C oscillator, where the frequency is precisely determined by resistors R8, R14 and capacitors C25, C28. Trimmer-potentiometer R154 in the negative feedback circuit adjusts the amplitude.

11.2.3 MODE SELECT CIRCUIT

This circuit is based on transistor Q17, inverter U29E, gate U27C, flipflop U26B with U27D (Fig 11-4), and analog switch U28A (Fig 11-5).

When a low Z-Mode signal is received from the Z-photocell on terminal P10-3 (Fig 11-4), it is inverted by U20E and, when a Bond 1 high signal (logic “1”) is present too, opens U27C and sets the flipflop. The high Manual Z signal is thus produced and applied to the summing point (Fig 11-5). This signal also turns off, via inverter U31C, analog switch terminals U28A-2,3 thereby shorting out all preset parameters coming via analog switch U12; and in addition, it turns on terminals U28A-14,15 to feed the summing point directly from the Z-LVDT amplifier U33D via isolating resistor network RN15.

Immediately after the 2nd bond, just before capillary rise, the flipflop is reset by the high output of gate U25C at input U26B-3. The inputs of the U25C are then a low End of Bond pulse from U31E and the low Bond 1 signal, which thus cause the capillary to rise to RESET position back in the chessman mode.

11.2.4 Z-LVDT AMPLIFIER

This circuit is based on operational amplifier U33D (Fig 11-5).

The circuit is fed with the Z-LVDT output rectified by the full-wave diode bridge CR48-CR51 and filtered by an R-C network. The output is applied to analog switch terminal U28A-15 which, when in the manual Z mode, is connected with terminal U28A-14 to feed the summing point.

11.2.5 POSITION MULTIPLEXER

This circuit is based on analog switch U12 and optocoupler U7 (Fig 11-5).

Terminals U12-7,2,15 receive the 3 dial reference voltages: 1st SEARCH, 2nd SEARCH, LOOP, via terminals P12-15,12,13 respectively. When any of the three corresponding control signals: Loop, 1st, 2nd on terminals U12-8,1,16 goes high from the logic, its own pair of terminals in U12 is turned on and the reference voltage is applied to analog switch terminal U28A-2 to reach the summing point as a second input.

The two reference voltages RESET and OVERTRAVEL are fixed – Reset reference at +8V when optocoupler U7 is activated via transistor U21D by a high Reset signal; and Overtravel reference at –8V when a high Overtravel signal comes in from the logic.

11.2.6 POSITION DETECTOR

This circuit is based in 5 comparator U17A-U17D and U33C (Fig 11-5).

The reference voltages for these comparators are obtained as follows:
At the Reset comparator input U33C-9, the +V REF from the DC power supply +8V output (Fig 11-2); at the Loop, 1st Search and 2nd Search comparators U17B, U17D, U17A non-inverting inputs – from their respective reference sources on the position multiplexer terminals U12-7,2,15;
At the Overtravel comparator input U17C-9, the V REF voltage form the DC power supply –8V output. The inverting/non-inverting reference inputs connection depends on the bonding head direction of motion at each of these phases.

The position signals are taken from the LVDT through the position feedback amplifier.

The 5 outputs of this circuit are applied to the logic to advance the cycle every time to the next phase. The only output that is used low is the O.T Position, due to its negative reference voltage, inverted by U14C for producing the high Bond Delay signal for the force/power delay circuit (Fig 11-3) once the motor has reached the maximum (equivalent OVERTRAVEL) position. (Gate U14D is spare).

11.2.7 POSITION FEEDBACK AMPLIFIER

This circuit is based on operational amplifiers U23A-U23D with U22C and U22D (Fig 11-5).

The main LVDT output is rectified by the full-wave diode bridge CR53-CR56, capacitor-filtered and applied as a variable DC voltage to the inputs of both U23A and U23D, forming a differential amplifier with U23B. The output of U23B is amplified by U23C, the Position output of which is applied to the Reset comparator variable input U33C-10 of the position detector.

The Position output signal of U23B is applied via isolating resistor R66 to the summing point. It is also amplified by U22C and U22D after level-shifting by diodes CR72 (positive) and CR73 (negative) for obtaining the required leveling, and applied as further Position signals to the variable inputs of U17A-U17D of the position detector.

11.2.8 SPEED FEEDBACK AMPLIFIER

This circuit is based on operational amplifier U33B and analog switch U28B (Fig 11-5).

The tachometer signal, proportional to motor speed, enters at terminal P6-4, it is filtered by capacitor C92 and amplified by U33B. In the chessman mode, when U28B is turned off, variable resistor R152 adjusts the stage feedback gain and therefore controls the motor speed that ultimately depends on the motor tachometer feedback gain. The output of U33B is applied to the summing point via resistor network RN15.

In the manual Z mode, U28B is turned on by the high Man Z signal from the mode select circuit (Fig 11-4) and shorts out R152 for a lower gain suitable for slower manual speeds.

11.2.9 SERVO MOTOR POWER AMPLIFIER

This circuit is based on operational amplifier U1, power transistors Q10 and Q13, and analog switch U28C (Fig 11-5).

The amplifier input is the sum of 3 signals – from the mode select circuit, from the speed feedback amplifier and from the position feedback amplifier – via isolating resistors that also perform the electronic summing function. The negative feedback voltage via resistors R80, R85 determines the stage gain.

In the manual Z mode U28C is turned on by the high Man Z signal from the mode select circuit (Fig 11-4), shorting out R80 for a lower gain suitable for slower manual speeds.

11.2.10 FORCE ACTUATOR MULTIPLEXER

This circuit is based on operational amplifier U22B, transistor Q4, analog switch U16A and electronic switch U21E (Fig 11-3).

There are 4 levels of the input signal, obtained from different sources including the logic. Transistor Q4 is a current source having a negative feedback loop common with U22B via resistor network RN6. The output current is determined by the voltage across resistor R21, which in turn depends inversely on the output voltage of U22B. When the circuit is quiescent, the Constant force input voltage at terminal U22B-5 is fixed and determined by voltage divider RN6-R63, all other voltage paths being cut off.

When a high tracking signal arrives at the electronic switch terminal U21E-5 from the logic (Fig 11-4), this switch (transistor) conducts and lowers the input voltage at U22B-5, thereby increasing the output current to the Tracking force level. This is again restored to Constant force level when the Tracking signal drops again to low at 1st SEARCH position, from the logic.

When a high timing pulse for Bond 1 force (F1) subsequently comes out of gate U15B of the delay circuit, it turns on analog switch terminals U16A-3, 2. The 1st FORCE dial reference voltage on terminal P12-10 is allowed through as the input level, and the output current is thus raised to the Bond 1 Force level. When bonding time is over, as set by the 1st TIME dial voltage on terminal P8-4, the timing pulse disappears and Constant level is restored.

When the second timing pulse appears at gate U15C output, the 2nd Force level is produced in a similar manner, according to the 2nd FORCE dial reference voltage on terminal P12-11 and the 2nd TIME dial voltage on P8-5.

11.2.11 FORCE/POWER DELAY AND FORCE ACTUATION CIRCUITS

These circuits are based on monostable multivibrators U11B, U10A, U10B and inverting gates U15A-U15D (Fig 11-3).

When bonding head touches down on the device, a high Bond Delay signal is received at U11B-12 from the position detector (Fig 11-5), and after a delay determined by resistor R59 and capacitor C55, a high pulse appears at output terminals U11B-9,11. This pulse is applied both to U10A and to U10B, only one of which is on according to the presence of a high Bond 1 or Bond 2 signal at terminal U10A-3 or U10B-13 respectively, from the logic (Fig 11-4). After a further delay, a low pulse appears at the relevant output terminal U10A-7 or U10B-11, which is then applied to the respective inverting gate input terminal U15B-6 or U15C-8, to produce a high output for analog switch U16A.

The same result can be obtained by a low output signal from inverting gates U15A, U15D respectively. When either Set-up signal via terminal P7-8 or Man Z signal from the speed feedback amplifier (Fig 11-5) is low at the inputs of inverting gate U14B, the output of this gate is high, enabling U15A and U15B – whichever receives a high Bond 1 or Bond 2 signal at the other input. The low output of the open gate then acts on U15B or U15A as above. In this case, bonding forces are applied continually, as long as either the SET-UP/RESET switch is UP or the Z-lever is operated until rising back to RESET. This makes up for the absence of the Tracking force from the logic.

The high Bond Delay signal also causes a high pulse on output terminal U11B-10, driving the OVERTRAVEL LED DS2 (LED 2) to emit a single short flash.

11.2.12 U/S GENERATOR

This circuit is based on PLL U5, analog switch U6, operational amplifier U4 and switch S1 (Fig 11-3).

The PLL generates a square-wave signal at a frequency determined by the transducer resonance, namely at minimum phase between voltage and current. The 90º-shifted voltage built up across the transducer series capacitor C20 is fed back to input terminal U5-2 via DC-blocking capacitor C33 and voltage dividerR130-R36. Variable resistor R153 adjusts the open-loop frequency. The U/S output on terminals U5-4,5 is applied via voltage-dropping resistors R5 and R12 to terminal P8-6, to be returned from the two POWER dials at terminals P3-8, 24. When any of analog switch U6 two terminal pairs is turned on by a high signal from terminal U10A-6 or U10B-10, the relevant U/S signal is allowed through via an R-C attenuating circuit into power amplifier U4. At the same time, the high output pulse of U10A or U10B causes by gate U9A and inverter U20A a high signal at gate input terminal U9B-6. The low output of this inverting gate turns off analog switch terminals U6-10,11 that normally ground the U/S signal paths via resistor R135 for prevention of oscillations at U4. The output of U4 is stepped down and isolated by transformer T1 and finally applied to the U/S jack J1. The U/S POWER HIGH/LOW switch S1 shorts out R12 for greater signal level when at HIGH. The high output pulse from U10A or U10B causes a low output pulse from gate U9A. This pulse is inverted by U20A and delayed by resistor R65 and capacitor C60 to produce, at gate U14A inputs, the End of Bond low output pulse for the logic.

11.2.13 U/S TEST CIRCUIT

This circuit is based on operational amplifiers U3D and U3C, comparator U3B, inverter U20B and gate U9B (Fig 11-3).

The transducer voltage, highest at resonance, is rectified half-wave by U3D due to diode CR30, filtered and amplified by U3C, and finally applied to comparator terminal U3B-5. The reference voltage of U3B is normally low from inverter U20B output via diode CR47. When the TEST switch is operated, a low signal enters on terminal P7-3, U20B output goes high, diode CR47 is cut off, and U3B reference voltage goes higher as determined by voltage divider via isolating diode CR27 and terminal P8-1 to the U/S LED, while terminal U6-1,2 now pass the U/S signal into the transducer. Terminals U6-10,11 are off by U9B low output.

11.2.14 SOLENOIDS DRIVE CIRCUIT

This circuit is based on monostable mutivibrators U11A and U30, analog switch U16, timer U37, and the associated logic (Fig 11-6).

Timer U37 is an oscillator that generates at terminal U37-2 a triangular-wave signal for both the wire clamp and the drag clamp solenoids. U11A produces trigger pulses for both the wire clamp and the kicker solenoids.

11.2.14.1 WIRE CLAMP SOLENOID

This circuit is based on flipflop U25A-U24B, gates U32A and U32D inverter U31A, comparator U36D, power transistor Q2 and timer U37.

When both Bond 1 signal at terminal U11-a-3 and Reset Position signal at terminal U11A-5 are high, and with both Power On and Tail Control signals high at flipflop input terminals U24B-3,4, the low trigger pulse from terminal U11A-7 sets the flipflop to produce a low output at terminal U24B-6.

As a result, the high output from inverting gate U32A, together with a high pulse from comparator U36D caused by the triangular output of timer N37, opens inverting gate U32D. The low output of U32D is inverted by U31D and drives electronic switch (transducer) U34G into conduction. This in turn drives Q2 into conduction as well, driving a current pulse through the wire clamp solenoid via terminals P1-4,3. The inverting input U36D-13, fed from across the voltage-drop resistor R123 filtered by capacitor C105, forms a negative-feedback loop that insures that subsequent current pulses through the solenoid will be of a shorter duration, being constantly chopped off at the comparator, once the initial drive has energized the solenoid. Diode CR108 protects Q2 against solenoid back-emf.

The same result is obtained also when the input signal on terminal P7-2, from the CLAMP switch, is low when the switch is operated.

Wire clamp solenoid release is determined by the tail control circuit, inhibited only by a low Bond 1 signal at input terminal U11A-3 in stitch bonding.

11.2.14.2 TAIL CONTROL CIRCUIT

this circuit is based on comparator U36B and U22A, flipflop U8C-U8D, gates U26C and U18B, inverter U31B, and operational amplifier U36A.

The circuit enables wire clamp solenoid for precise tail formation. When the solenoid is to be energized, the output of comparator U22A is low, the output of gate u18B is high, and flipflop U25A-U24B can be set for solenoid operation.

During the cycle, the positive output at gate terminal U8D-11 turns on the analog switch terminals U16B-14,15 and permits the Position signal from the position feedback amplifier (Fig 11-5) to charge capacitors C62 and C63 accordingly. At the same time, the Position signal from the same source is applied to operational amplifier terminal U26A-2, lever-shifted by the TAIL potentiometer R151. The two input voltages of U22A are thus changing closely together, both following the Position signal variations but with a small voltage gap between them. Because of possible instability at U22A output due to this small gap, gate U18B is blocked during this time by the low output from flipflop terminal U8C-10.

When flipflop U8C-U8D is finally reset, terminals U16-14,15 are turned off, capacitors C62 and C63 remain at the turnoff momentary voltage, and the output of U36A reaches the capacitor voltage after a short delay depending on R151 adjustment. When this happens, the output of U22A goes high and, with input U18B-5 high too, causes a low output from U18B. This resets flipflop U25A-U24B, causing current cutoff and solenoid release.

Flipflop U8C-U8D is set by the Start low signal at terminal U8D-13 from the logic (Fig 11-4), at every RESET position or when the SET-UP/RESET switch is on RESET. At this state, U8D output is high and it turns on analog switch U16 as described above.

Flipflop U8C-U8D is reset by a low input at terminal U8C-8, when all inputs of inverting gate U26C are high: Bond 1 signal at terminal U26-13 from the logic; Contact Pin signal inverted by U31B from the low signal on terminal P4-2, coming from the contact pin when connected; and Speed signal from comparator U36B, by a low signal from the speed feedback amplifier (Fig 11-5) when the bonding head is rising. As can be seen from the time study (Fig 7-1), this triple condition is indeed necessary for the wire clamp release: “Bond Select: is “Bond 1”, “Contact Pin” is “Connected”, and “Main LVDT Core” is moving back (motor reversed). At this moment, the flipflop output at terminal U8C-10 is high to enable comparator U22A high output through gate U18B for current interruption as described above.

11.2.14.3 DRAG CLAMP SOLENOID

This circuit is based on flipflop U25D-U24C, gates U25B and U32C, inverter U31E, electronic switches U34A and U34F, power transistor Q1, and timer U37 (in common with the wire clamp solenoid circuit).

When Bond 1 signal from the logic goes low at the flipflop input terminal U25D-12 (end of Bond 1), this alone is a sufficient condition for energizing the drag clamp solenoid, as can be seen from the time study (Fig 7-1). This signal therefore sets the flipflop, and the high output from the terminal U25D-11 enables gate U32C via isolation diode CR113 for comparator U36C output. The rest of the output circuit is identical with that of the wire clamp solenoid discussed above.

Flipflop U25D-U24C is reset for solenoid release by the low output of gate U25B when both Reset Position signal from the position detector.(Fig 11-5) and Bond 1 signal from the logic (Fig 11-4) are high. As can be seen from the time study (Fig 7-1), this double condition is necessary for the drag clamp release: “Main LVDT Core” is back at rest (Bonding head at RESET), and “Bond Select” is “Bond 1”.

The drag clamp solenoid is also energized by the Clamp low signal at terminal P7-2, together with the wire clamp solenoid, when the CLAMP switch is operated. The signal drives electronic switch U34A into cutoff, raising the collector voltage to the supply level and, via isolation diode CR114, enabling gate U32C as before.

11.2.14.4 KICKER SOLENOID

This circuit is based on flipflop U32B-U24A, electronic switch U34E, and monostable multivibrator U11A (in common with the wire clamp solenoid circuit).

When both Bond 1 signal from the logic and Reset Position signal from the position detector (Fig 11-5) are high at input terminals U11A-3,5 respectively, a low pulse is generated at output terminal U11A-7. This pulse, at input terminal U32B-5, sets flipflop U32B-U24A, and the high output of U32B drives electronic switch (transistor) U34E into conduction and energizes the kicker solenoid via terminals P1-1,2. Diode CR109 protects U34E against solenoid back-emf.

The kicker is released when Bond 1 signal goes low (end of Bond 1) at the flipflop input terminal U24A-1, a condition that can be seen from the time study (Fig 7-1).

11.2.14.5 EFO SOLENOID

This circuit is based on monostable multivibrator U30, transistor Q18, electronic switches U21A and U21B, and flipflop U25D-U24C (in common with the drag solenoid circuit).

When the drag solenoid is released by the Reset Position and Bond 1 high signals (see above and Fig 7-1), the low output of U25D triggers at input terminal U30-10. This pulse drives transistor Q18 into conduction, which, in the emitter-follower configuration, causes the emitter to drive both U21A and U21B into conduction. U21B energizes the relay on the EFO board via terminals P15-1,2 (the relay prevents constant high-voltage charge on the EFO electrode).

11.2.15 LOGIC

The logic consists of 6 flipflops, U8A-U13B, U18A-U13C, U19B-U29B, U29D-U19C, U18C-U13A, U9C-U9D, analog switch U16C, type J-K flipflop U35A, electronic switches U21F, U21G, and the associated logic (Fig 11-4). The mode select circuit is excluded (see 11.2.3 above).

When the machine is turned on, the +15V from the DC power supply gradually charges capacitor C71 through resistor R75. During this time, this initial low level across C71 sets flipflop U19B-U29B to produce a high Reset signal at output terminal U19B-6. At the same time, gate input U19A-2 is low and the low output of U20E resets the “Overtravel” flipflop U18C-U13A at input terminal U13A-2, as well as the “2nd” flipflop U18A-U13C at input terminal U13C-13, producing low O.T. and “2nd” outputs. The “1st” flipflop U29D-U19C is reset at terminal U19C-11 by the low output of gate U25C. The “Loop” flipflop U8A-U13B is reset at terminal U13B-3 by the low Bond 2 output signal from flipflop U35A. This signal, at gate input terminal U8B-6, also blocks the gate as a protection against premature operation of the "Loop" flipflop by the End of Bond signal at the other input. Thus, only the "Reset" flipflop is set at first, whether on machine turn-on or at every new cycle, since the high Reset Position signal at U20B input, from the position detector, also causes the low Start signal.

The same result is obtained by a low signal at terminal U19A-8 via terminal P7-4 from the SET-UP/RESET switch when on RESET.

The high Reset output signal drives the motor, through the position multiplexer and the servo motor power amplifier (Fig 11-5), to the RESET position. All this time, the low Reset Position signal from the position detector blocks gate U29A against any attempt of a high signal on terminal U29A-2 to set the "1st" flipflop prematurely. IN addition, the low EFO Delay and EFO signals from the EFO board (Fig 11-6) prevent analog switch U16 from premature turn-on. After the EFO has been given, U16C turns on by the +15V supply via R138. When RESET position is finally reached, the Reset Position high signal from the position detector (Fig 11-5) enables gate U29A.

When a low input is received at terminal P5-2 from the CHESSMAN BUTTON, It is inverted by U20D. The high output of U20D, enabled by the high Reset Position signal at the U29A inputs, causes a low output that sets the "1st" flipflop, producing a high "1st" output signal. The U29A output also resets the "Reset" flipflop at input terminal U29B-6.

The motor now runs the machine to the 1st SEARCH position. When reached, the high 1st Position signal from the position detector at gate input U29C-8 enables the gate for the expected high signal on the CHESSMAN BUTTON release, from the +15V supply through RN7. The low output of U29C resets the "1st" flipflop. The high output on its terminal U19C-10, enabled by a high output from the "2nd" flipflop on terminal U18D-13, causes a low U18D output and, after differentiation for a negative-going pulse, sets the "OT" flipflop. This low Tracking output signal from U18D is applied to the force actuator multiplexer (Figure 11-3) for producing the Tracking force (Figure 7-1).

When a low End of Bond pulse is received from the force/power delay circuit, and inverted by U31A, it sets one-shot flipflop U9C-U6D, causing J-K flipflop U35A to produce a high Bond 2 signal at output terminal U35A.

After the 1st Bond is made, the End of Bond low pulse appears at inverter U31A input from the force/power delay circuit (Fig 11-3). This pulse is used in its up-going (training-edge) phase, giving a small delay. The low output of U31A is differentiated to give a negative-going pulse at inverter U31E input. The high output pulse from U31E enables gate U8B for the high Bond 2 signal from U25A, and the low U8B output sets the "Loop" flipflop, sending the high Loop signal to drive the motor.

When the LOOP position is reached, a high Loop Position signal enables gate U27B. A low signal coming in at terminal P5-2 from the CHESSMAN BUTTON via analog switch U16 and inverter U20D, causes a high input at gate terminal U27B-6. The low output of this gate resets the "Loop" flipflop at input terminal U13B-4. The low flipflop output at terminal U8A-3, through a differential network, produces a negative-going pulse that sets the "2nd" flipflop U18A-U13C. The high "2nd" output signal is sent out to drive the motor.

When the 2nd SEARCH position is reached, the high 2nd Position signal from the position detector at gate input U26A-1, which as a low signal has blocked the gate as protection against premature operation, now enables the gate for the expected high release signal of the CHESSMAN BUTTON. With input U26A-8 high too, from the reset "Loop" flipflop output terminal U13-6, the "2nd" flipflop is eventually reset.

A low LED 2 signal received from the force/power delay circuit at terminal U9D-13 now resets the one-shot flipflop U9C-U9D causing from terminal U9D-11 a Bond 1 high output from the J-K flipflop U35A. This signal enables gate U25C for the End of Bond high pulse from inverter U31E. The low output pulse of U25C sets the "Reset" flipflop, driving the machine to RESET position for the next cycle. The Reset Position high signal at inverter U20B input now produces a new Start signal that resets the other flipflops. The low output of U20B also drives RESET LED DS1 (LED1).

When the STITCH BUTTON is used, the low Stitch signal on terminal P5-3 holds flipflop U9C-U9D set as long as the button is pressed, securing the Bond 2 high signal from the J-K flipflop U35A (stitches are "2nd bonds").

The Bond 1 and Bond 2 signals also turn on electronic switches U21G and U21F, in turn driving front panel LED 1 ("1st") and LED 2 ("2nd") via terminals P12-2 and P12-1 respectively, each in its due time.

11.3 EFO BOARD CIRCUIT DESCRIPTION

This circuit is based on 13 capacitor C3-C15 and relay K1 (Fig 11-9).

The input power, protected by varistor RV1, is stepped up by transformer T1. The secondary voltage, protected by varistor RV2, is rectified by diode bridge CR1-CR4. The 600 Vdc supply is filtered by capacitors C1 and C2 with resistors R1, R2 as bleeders.

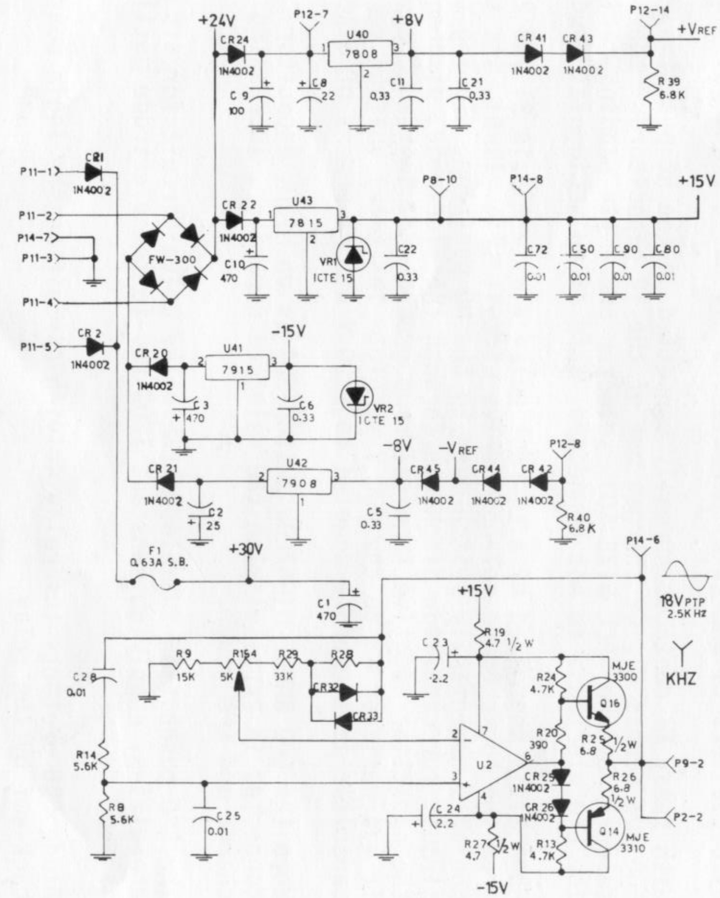
With relay K1 contacts normally connected in the NC position, the 600 Vdc across C1, C2 charges one of the 12 capacitors - the one selected by the BALL SIZE ADJ. selector SW2 - via padding resistor R4. The EFO electrode is not connected, safe at an accidental touch.

When K1 is energized by a current pulse via terminals 21 and 22, from the logic board solenoid drive circuit (Fig 11-6), its two contacts momentarily switch over to the NO position, closing the circuit for capacitor discharge through the electrode, disconnecting the capacitor negative terminal from ground and, instead, connecting it via resistor R3 to the 600 V supply. The total voltage across the capacitor is therefore doubled to 1200 V at the moment of discharge.

When the EFO RANGE HIGH/LOW switch SW4 is on HIGH, capacitor C15 is connected in parallel with the selected capacitor, increasing total charge and EFO power.

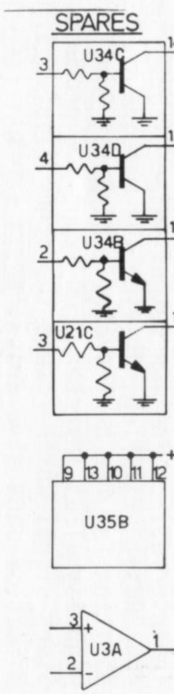
The EFO pushbutton SW3 closes the relay drive circuit for its manual energizing, supplying constant 1200 Vdc to the electrode until a ball is made.

Diode CR5 protects the relay driving circuit on the logic board against back-emf by the relay.



LOGIC BOARD IC DIRECT SUPPLY PIN CONNECTIONS

# U	IC	+15	−15	GND
1, 2	MC 741	—	—	—
3, 36, 33	MC 34004, TL 084	4	11	—
4	LM 380	—	—	3, 4, 5, 10, 11, 12
5	LM 565	—	—	—
6	MC 14016	14	—	7
7	4N 26	—	—	—
8, 14, 15, 18, 25, 29, 32	MC 14011	14	—	7
9	MC14001	14	—	7
10, 11, 30	MC 14538	16	—	8
12, 16, 28	DG 308	13	4	5
13, 19, 24, 26	MC 14023	14	—	7
17, 22, 23	MC 4741, LM 348	4	11	—
20, 31	MC 14049	1	—	8
21, 34	MC 1416	—	—	8
27	MC 14093	14		
35	MC 14027	16	—	8
37	LM 555		—	—



LOGIC BOARD NOTES:

UNLESS OTHERWISE SPECIFIED

1. RESISTORS ARE IN Ω, 1/4W, 5%.
2. RN (RESISTOR NETWORKS) ARE 10K Ω, 2%.
3. CAPACITORS ARE IN μF
4. DIODES ARE 1N914.
5. TERMINALS P14-1 THROUGH P14-8 ARE TEST POINTS.

FIG. 11-2 DC POWER SUPPLY - SCHEMATIC DIAGRAM (SHEET #1)

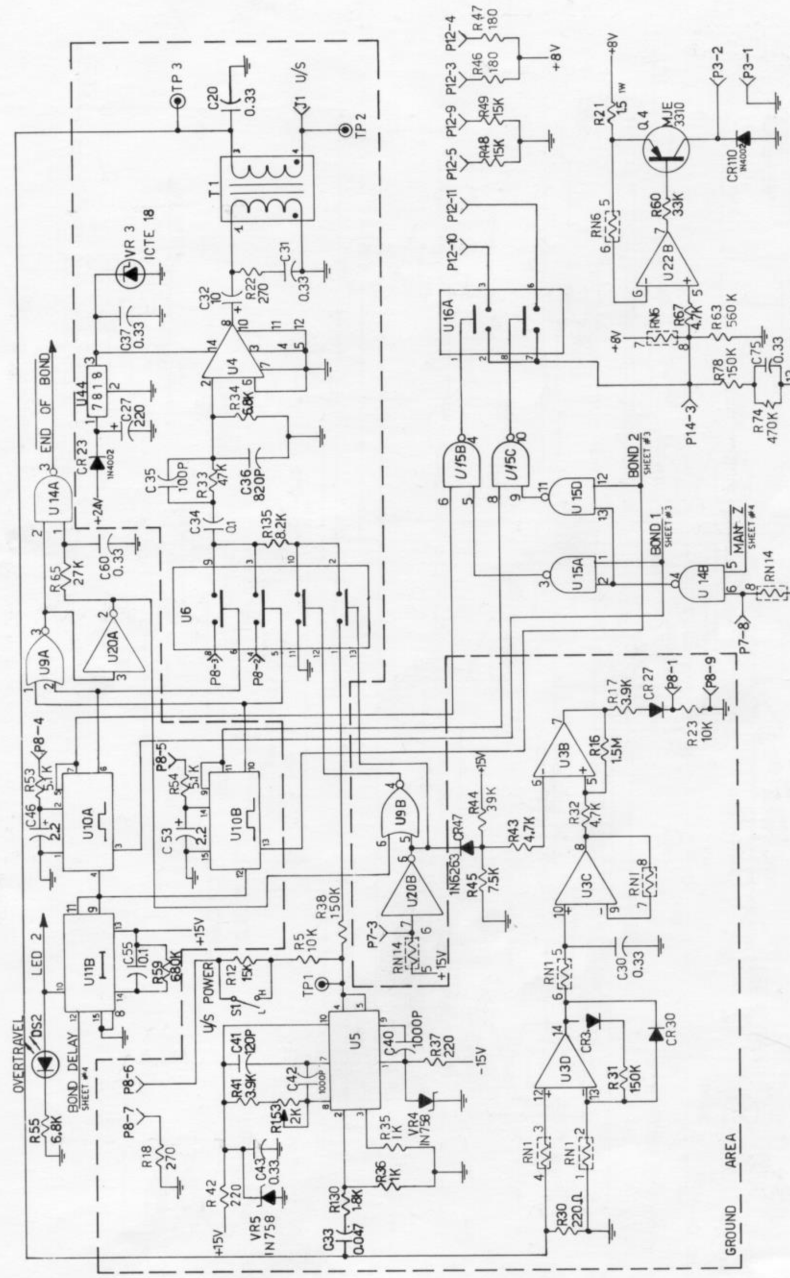


FIG. 11-3 ULTRASONIC AND FORCE ACTUATION CIRCUITS - SCHEMATIC DIAGRAM (SHEET #2)

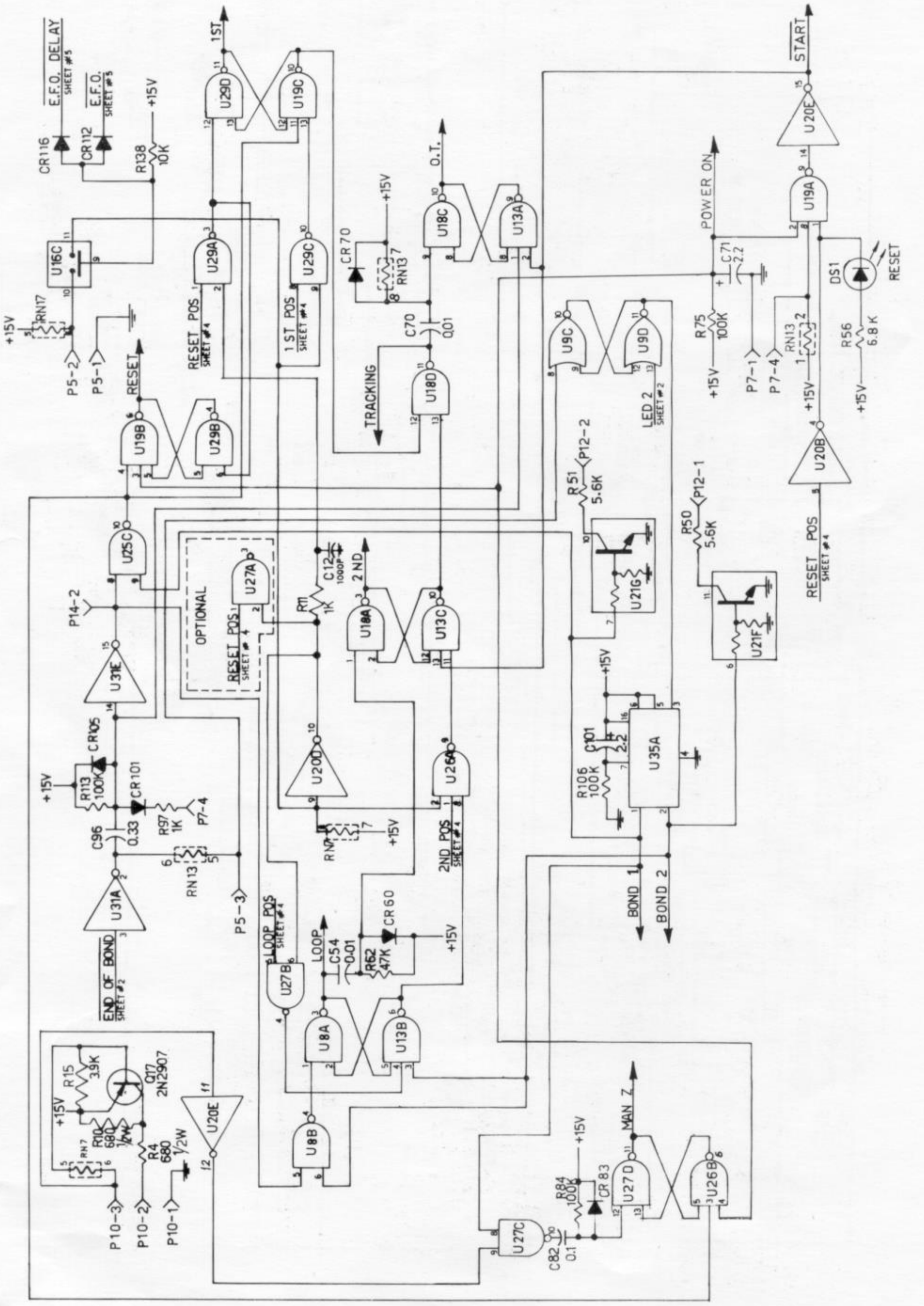
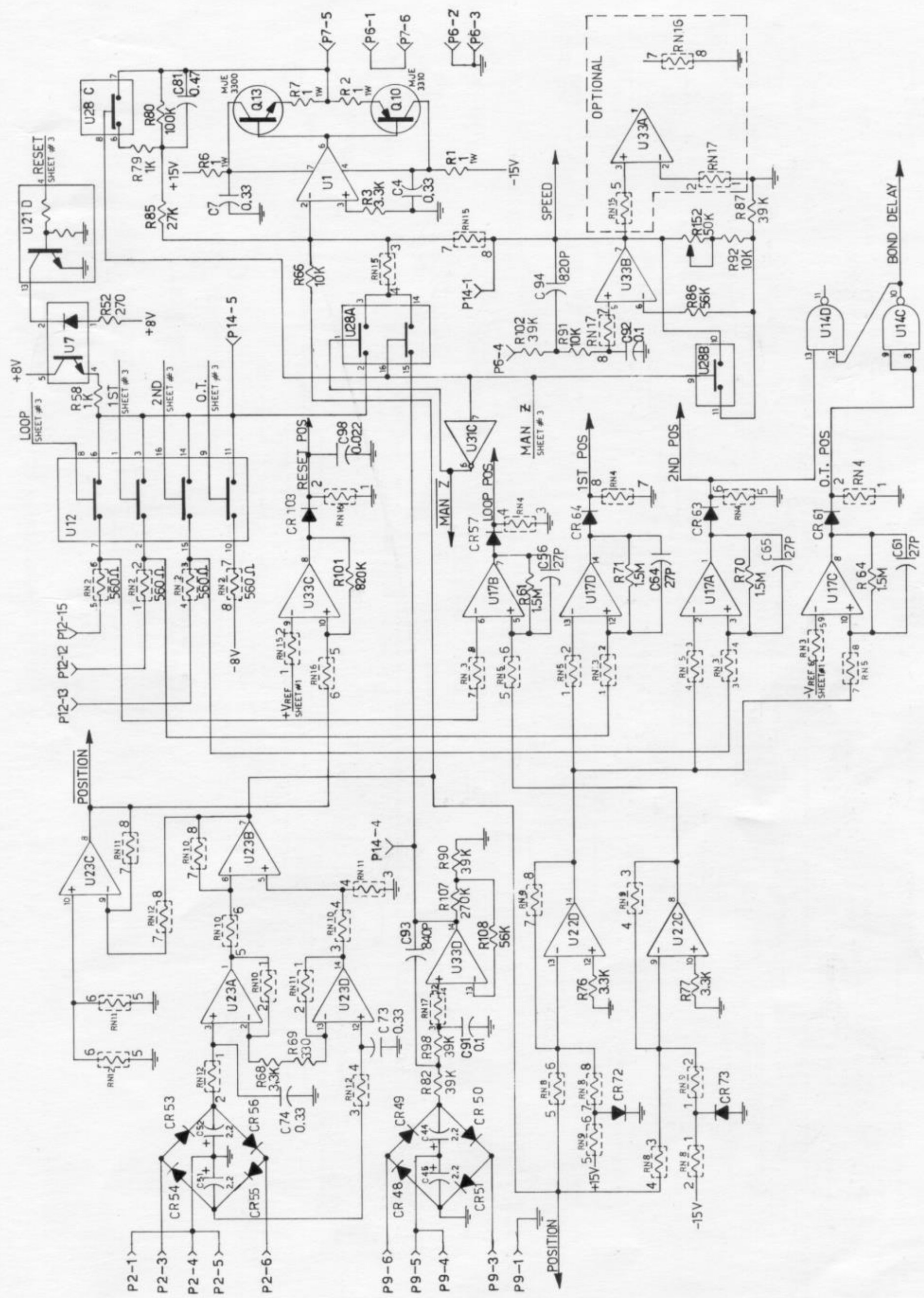


FIG. 11-4 LOGIC AND MODE SELECT CIRCUITS - SCHEMATIC DIAGRAM (SHEET #3)



FIS. 11-5 POSITION AND SPEED CIRCUITS - SCHEMATIC DIAGRAM (SHEET #4)

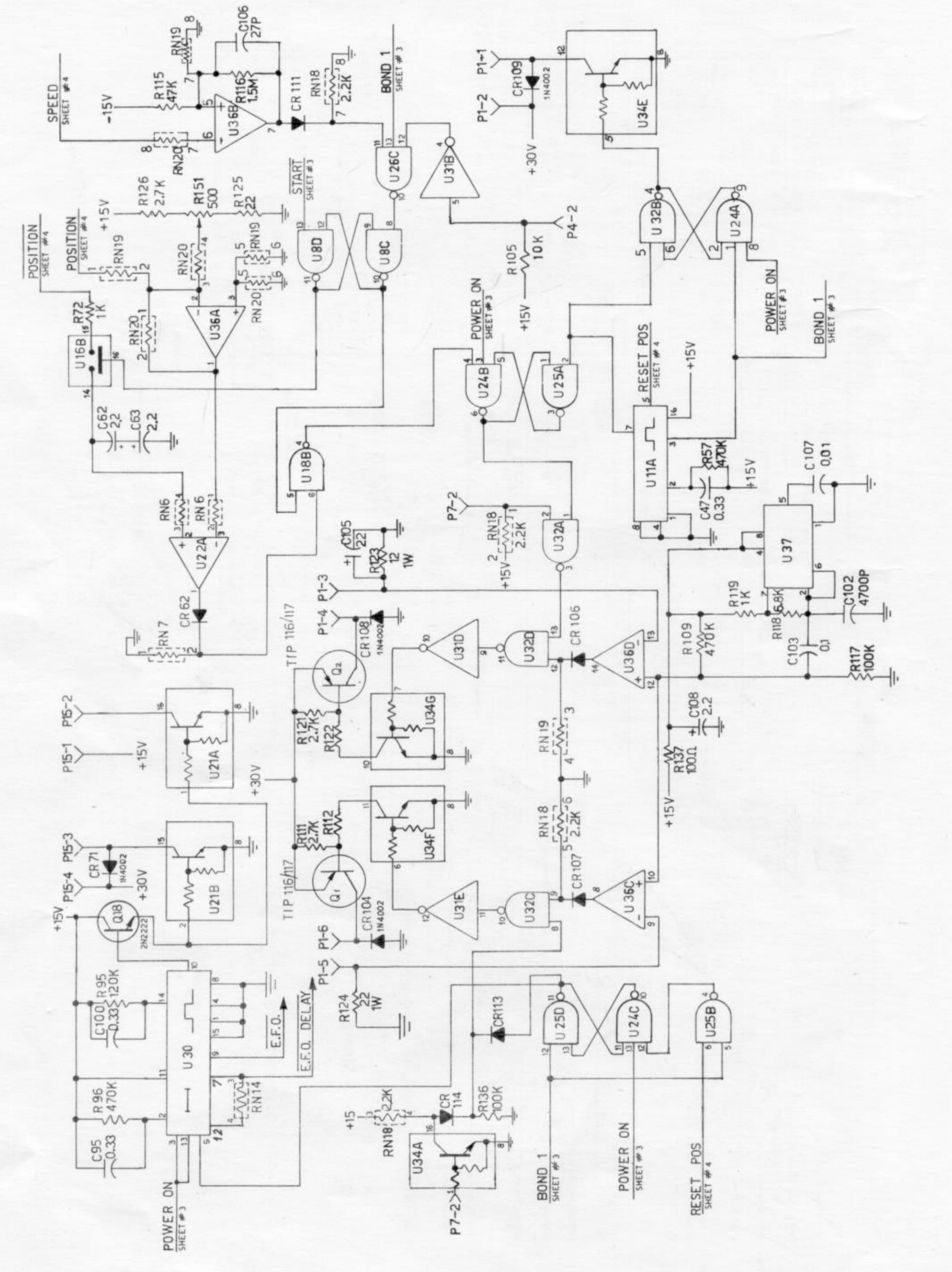


FIG. 11-6 SOLENOIDS DRIVE CIRCUIT - SCHEMATIC DIAGRAM (SHEET #5)

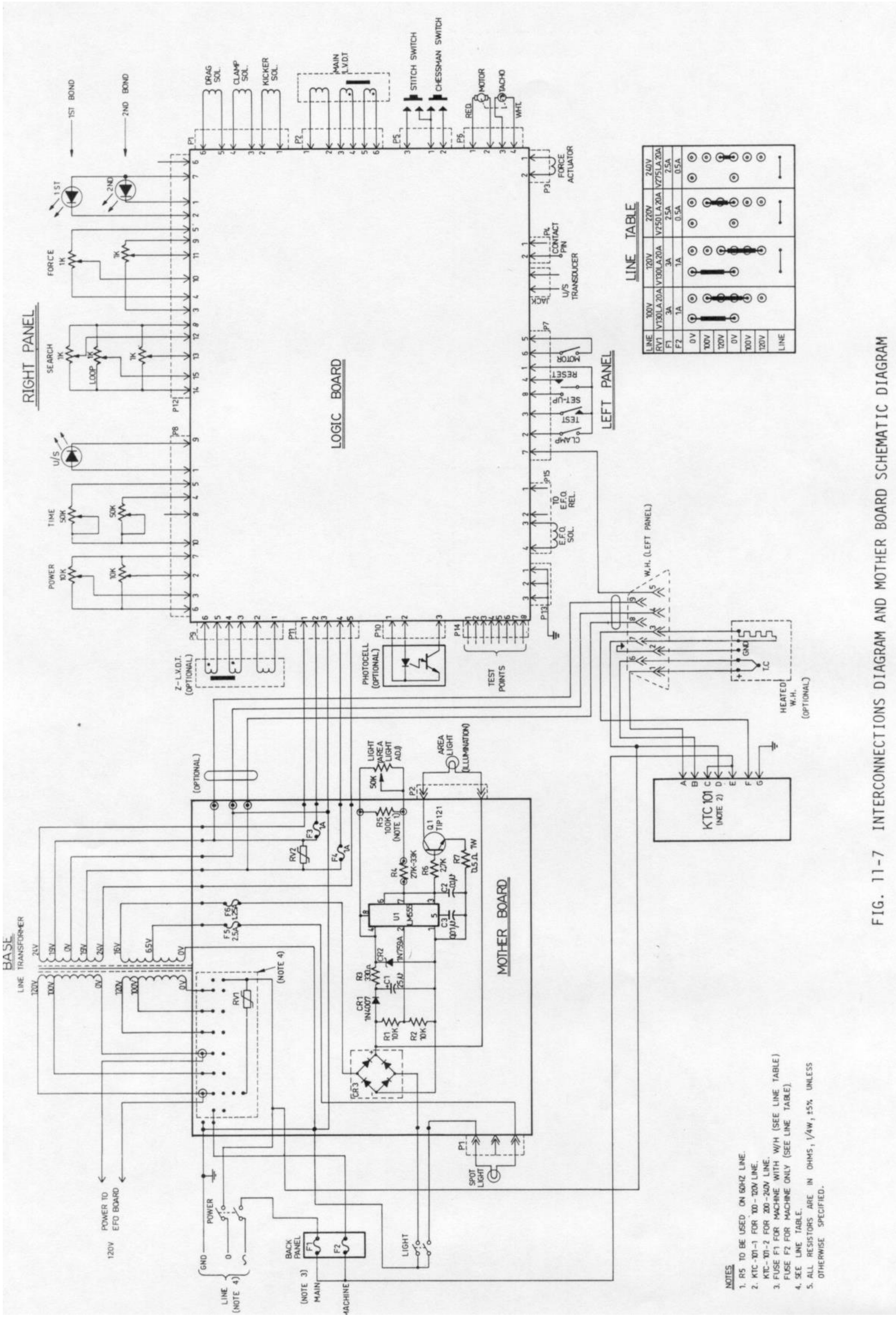


FIG. 11-7 INTERCONNECTIONS DIAGRAM AND MOTHER BOARD SCHEMATIC DIAGRAM

NOTES
1. R5 TO BE USED ON 60HZ LINE.
2. KTC-101-1 FOR 100-120V LINE. KTC-101-2 FOR 200-240V LINE.
3. FUSE F1 FOR MACHINE WITH W/H (SEE LINE TABLE) FUSE F2 FOR MACHINE ONLY (SEE LINE TABLE).
4. SEE LINE TABLE.
5. ALL RESISTORS ARE IN OHMS, 1/4W, ±5% UNLESS OTHERWISE SPECIFIED.

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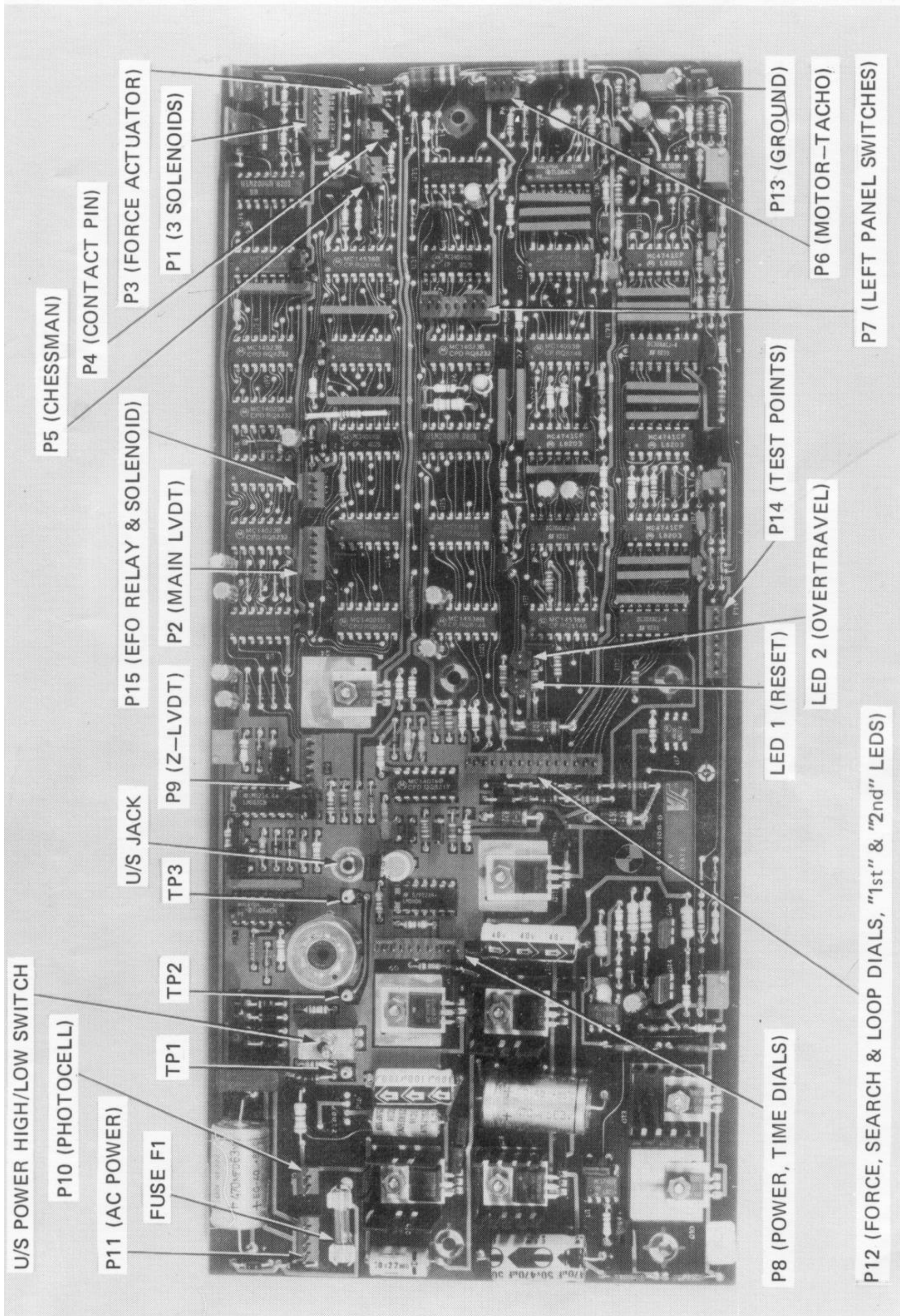


FIG. 11-8 LOGIC BOARD

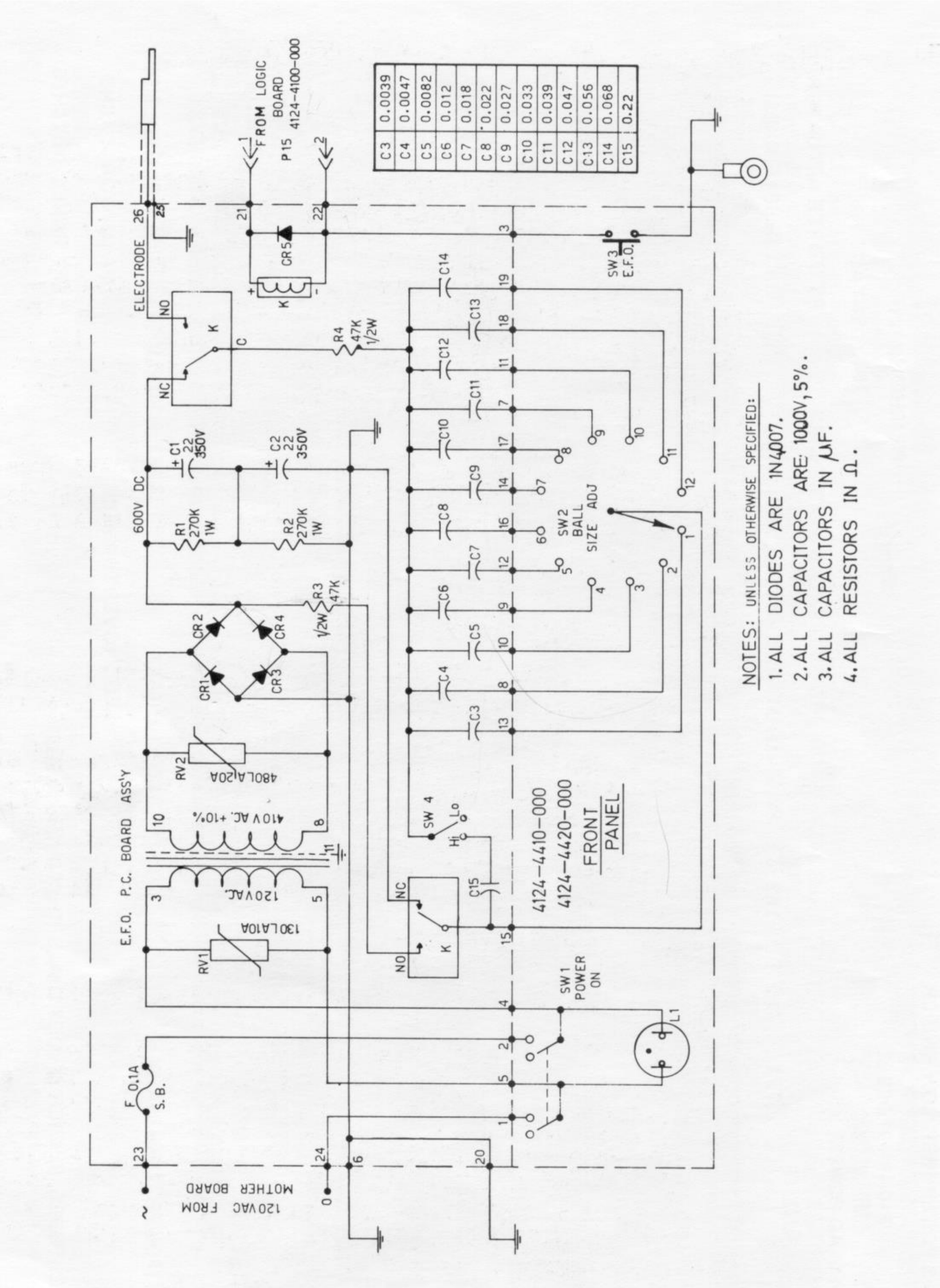


FIG. 11-9 EFO BOARD AND PANEL - SCHEMATIC DIAGRAM

11.4 TEMPERATURE CONTROLLER KTC-101 CIRCUIT DESCRIPTION

11.4.1 GENERAL DESCRIPTION

Temperature controller model KTC-101 powers an electrical load with the line voltages, sets the desired temperature, and displays both the actual and the set-point temperatures. The unit also includes a zero-offset circuit for compensating temperature differences between the heated element and the measured point; a cold-junction circuit compensating for the absence of a real 0ºC reference junction for which the thermocouple in use is designed; and a heat band (proportional band) circuit for diminishing the heating power gradually as the desired temperature is approached, so that the variations band (range) gets smaller and smaller.

The display is digital. A LOAD ON indicator lights when the load is being heated. Two OPEN T.C. indicators light in case the thermocouple is open and no heating takes place at all.

11.4.2 CIRCUIT DESCRIPTION

11.4.2.1 DC POWER SUPPLY

This circuit is based on transformer T1, rectifiers U1, U2, and voltage regulators U3, U4, U5 (Fig 11-10).

The line voltage, protected by varistors RV1 and RV2, is stepped down by T1, filtered by capacitors C1, C3, C4 and applied as DC inputs to regulators U3-U5. The regulated outputs are filtered by capacitors C2, C5, C6, and the +6.4 V and –4.7 V outputs are finally produced by zener diodes D2, and D3.

11.4.2.2 PREAMPLIFIER

This circuit is based on operational amplifier U6.

The thermocouple element T.C. is fed with an extremely small DC current from the +6.4 V supply via resistor R3. The T.C. voltage is applied via filter network R4-C7 to the non-inverting input of U6. Diode D4 protects against negative feedback loop adjusts gain, calibrating to the type of element used (J or K). Potentiometer R6 compensates for offsets at the U6 inner input circuit.

In case the T.C. is open, R3 drives the U6 input high, and via the display select circuit (see below) saturates U10 and drives the two OPEN T.C. LED’s.

11.4.2.3 COLD JUNCTION COMPENSATION CIRCUIT

This circuit is based on transistor Q1.

The diode-connected Q1, properly installed, senses the “cold junction” state of the thermocouple and changes its voltage accordingly. As a result, the voltage across resistor R13 partly shunted by Q1, is such that when added serially to the thermocouple voltage, a “cold junction” compensation is obtained at U6 input.

11.4.2.4 DISPLAY SELECT CIRCUIT

This circuit is based on switch SW1 and analog switch U8.

When the DISPLAY SELECT switch SW1 is on ACTUAL TEMPERATURE (button released), the +8 V supply reaches analog switch terminal U8-10 via resistor network RN1, turning on terminals U8-1,10 and allowing the output of U6 through to the A/D converter U10. The other pole of SW1 grounds terminal U8-16, turning off terminals U8-14,15 and disconnecting the set-point voltage.

On setting SW1 to SET POINT (button pressed), the reverse occurs – U6 output is disconnected while the voltage of SET POINT potentiometer R44 is allowed through via terminals U8-14,15 to the A/D converter terminal U10-31. This voltage is also constantly applied as a reference to the heat band control circuit for setting the desired limit to the actual temperature.

11.4.2.5 HEAT BAND CONTROL CIRCUIT

This circuit is based on operational amplifiers U9A-U9D and UJT Q4.

U9A amplifies the difference between the actual and set point voltages, namely, between U6 and R44 (moving contact) outputs. As long as these are unequal, output is high and load powering goes on. U9B is a sawtooth signal generator (about 1/3 Hz) based on Q4. Capacitor C11 is constantly charging via resistor R25 from the +8 V supply, and when reaching the break-even point of Q4, it is discharged at once vie Q4. The sawtooth wave thus produced across C11 is biased by a reference voltage from the PROPORTIONAL BAND potentiometer R30. This difference is amplified by U9B to give negative output pulses. The duty cycle of these pulses is determined by R30, and they serve at U9C inverting input as a reference for the steady-state output of U9A. The corresponding pulsating output of U9A is applied to the load drive circuit, and also to the LOAD ON indicator of display digit DS1 via resistor R45.

11.4.2.6 LOAD DRIVE CIRCUIT

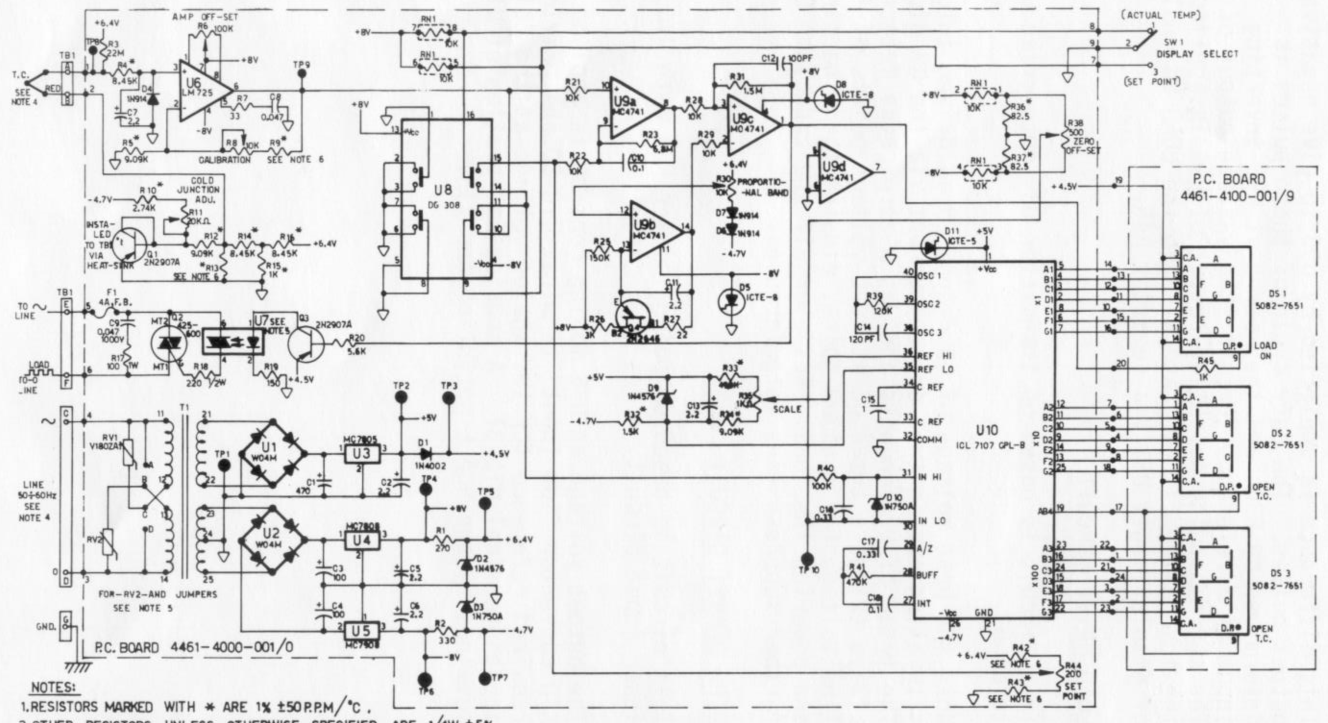
This circuit is based on transistor Q3, opto-triac U7 and triac Q2.

When the base voltage of Q3 drops, Q3 is driven into saturation and in turn drives current via the U7 diode. The triac of U7 conducts and, as a zero-cross detector, always triggers triac Q2 at zero-voltage points of the line voltage for minimum noise, closing the line circuit and powering the load. Resistor R17 and capacitor C9 further suppress line interferences.

11.4.2.7 ZERO OFFSET CIRCUIT

This circuit is based on potentiometer R38 with U10 inner input circuit.

The output voltage on R38 moving contact is applied to the A/D converter “low input” terminal U10-30 and provides the required reference foe the analog voltage at the “high input” terminal U10-31. A precise calibration of U10 is obtained by the SCALE potentiometer R35.



NOTES:

1. RESISTORS MARKED WITH * ARE 1% ±50 P.P.M/°C.
2. OTHER RESISTORS UNLESS OTHERWISE SPECIFIED ARE 1/4W, ±5%.
3. UNLESS OTHERWISE SPECIFIED RESISTORS ARE IN OHMS (Ω) AND CAPACITORS IN MICROFARADS (μF).

4.

T.C. / LINE	115V AC	230V AC
TYPE J	KTC-101-1 KS #4461-0000-000/2	KTC-101-2 KS #4471-0000-000/8
TYPE K	KTC-201-1 KS #4481-0000-000/3	——

5.

SOURCE / LINE	115V AC	230V AC
JUMPERS	A-B, C-D	B-C
RV 2	——	V180Z A1
U7	MOC3031	MOC3041

6.

RESISTOR	TYPE J	TYPE K
R 9	154 KΩ	205 KΩ
R 13	261 Ω	182 Ω
R 42	2.74 KΩ	1.82 KΩ
R 43	20 Ω	10 Ω

FIG. 11-10 TEMPERATURE CONTROLLER KTC-101 - SCHEMATIC DIAGRAM

12. OPTIONS AND ACCESSORIES

This section serves as reference file for specification sheets and bulletins describing K&S and MICRO-Swiss options and accessories for the Model 4124 Ball Bonder.

WORKHOLDERS FOR MODELS 4123/4124 BONDERS

1. 4135 GROUP: Represents the entire family of adjustable height rotary heated workholders.

   - 4135-1-0 Adjustable height rotary heated workholder for substrates and flat packages up to 2.5” x 2.5”.
   - 4135-2-0 Adjustable height rotary heated workholder for 24, 28, 40-lead DIL and side braze packages, dual station.
   - 4135-3-0 Adjustable height rotary heated workholder for 14-40-lead packages, 0.300” and 0.600” centerline, dual station.
   - 4135-4-0 Same as 4135-3-0 except single station.
   - 4135-5-0 Adjustable height rotary heated workholder with vacuum hold down for flat packages and substrates up to 2.5” x 2.5”.
   - 4135-6-0 Adjustable height rotary heated workholder for packages up to 1-3/4” x 3”.

2. 4142 GROUP: Represents the entire family of adjustable height stationary heated workholders.

   - 4142-1-0 Adjustable height stationary heated workholder for substrates and flat packages up to 2” x 2”.
   - 4142-2-0 Adjustable height stationary heated workholder for 24, 28, 4-lead DIL and side braze packages, dual station.
   - 4142-3-0 Adjustable height stationary heated workholder for 14-40-lead packages, 0.300” and 0.600” centerline, dual station.
   - 4142-4-0 Adjustable height stationary heated workholder with 0.100” between slots for packages up to 2” x 2”.
   - 4142-5-0 Adjustable height stationary heated workholder with vacuum hold down for flat packages and substrates up to 2” x 2”.
   - 4142-6-0 Adjustable height stationary heated workholder for TO-5, dual station.
   - 4142-7-0 Adjustable height stationary heated workholder for TO-18, dual station.
   - 4142-8-0 Adjustable height stationary heated workholder for TO-8, dual station.
   - 4142-9-0 Adjustable height stationary heated workholder for TO-3, single station.

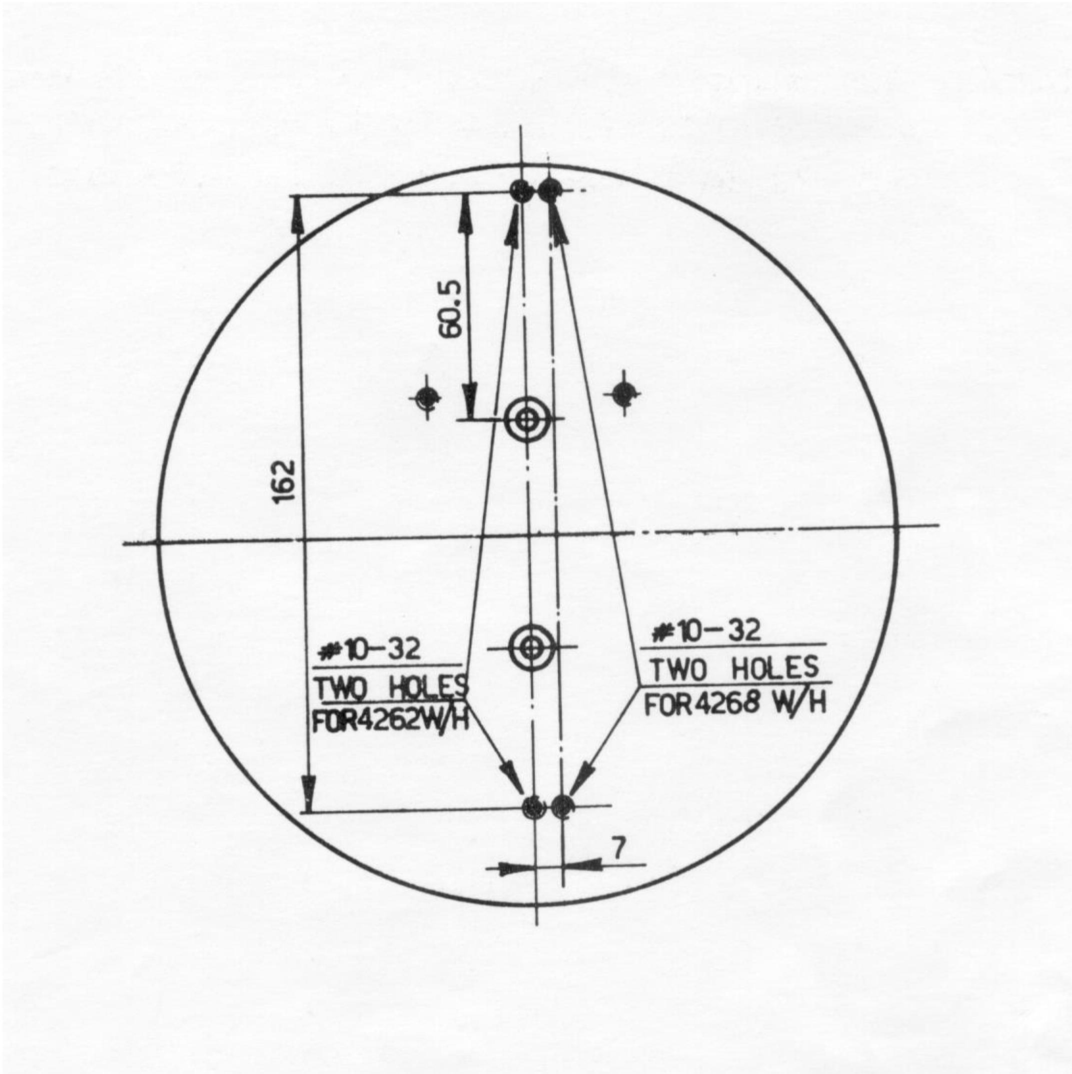


TABLE REWORK FOR 4262 AND 4268 TYPE WORKHOLDERS