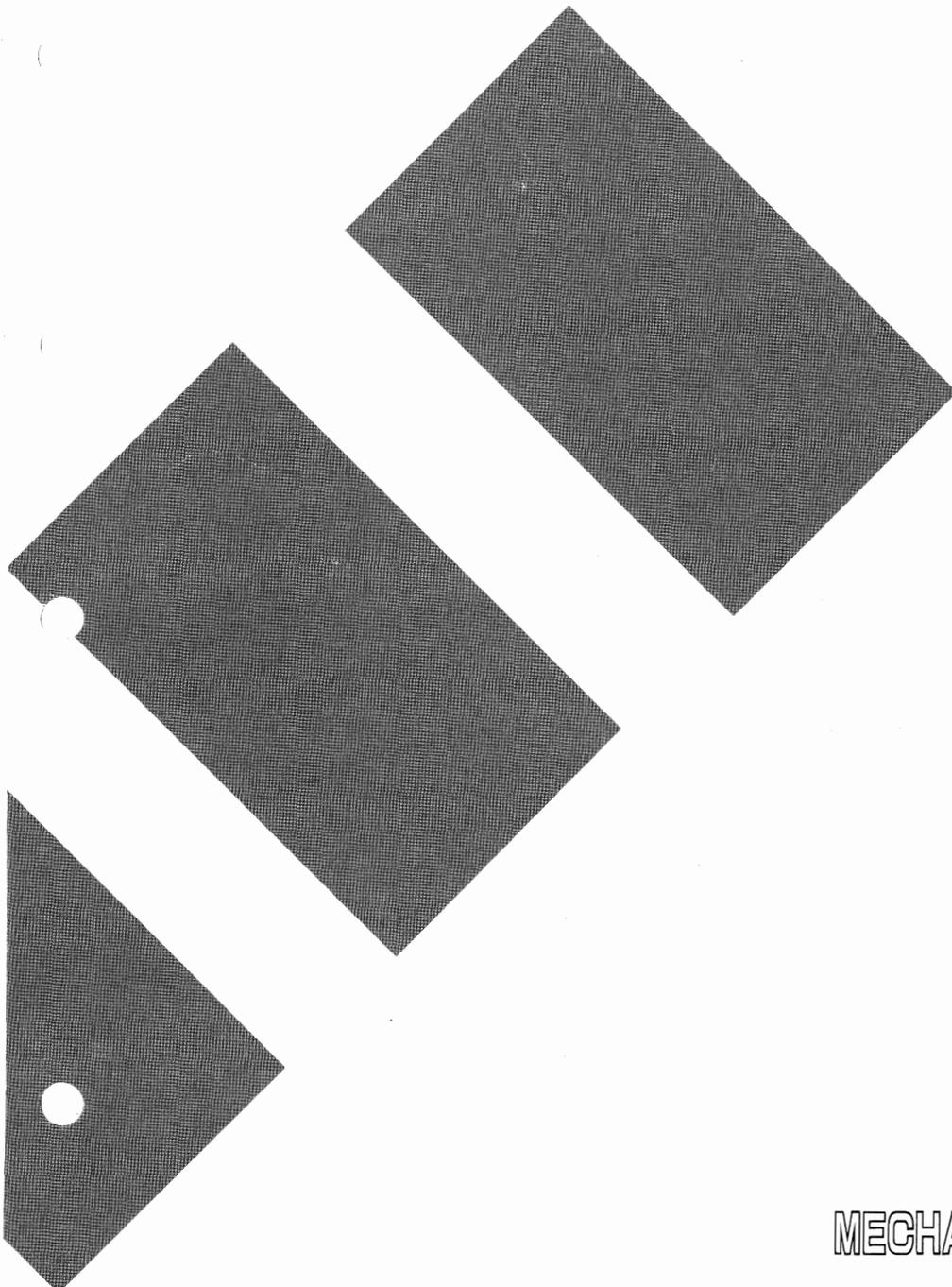


brother®

ELECTRONIC TYPEWRITER SERVICE MANUAL

MODEL : EP-5/150



MECHANISM & ELECTRONICS

SERVICE MANUAL

(Mechanical Part)

EP-5 & EP-150 TYPEWRITER SERVICE MANUAL

Mechanical Part

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CHAPTER III. LUBRICATION

1. LUBRICATION SPECIFICATIONS

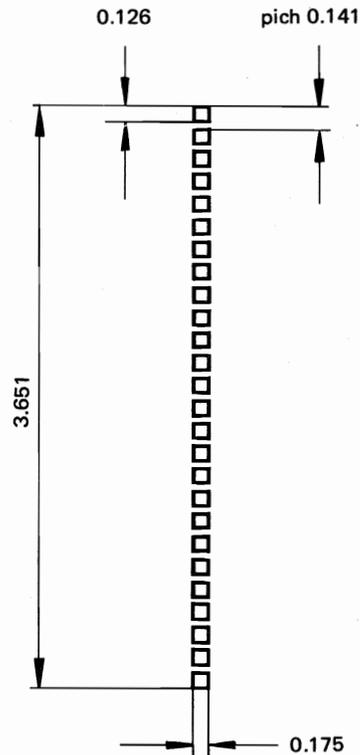
1.1 Lubricants

2. PRECAUTIONS

1.1.2 Character dot composition

(1) Thermal element composition

There are 26 thermal elements aligned vertically. The top one down to the 23rd are used to form characters. The 24th and 25th form underlines (The 26th element is not used for printing). Dot size is 0.126 mm height by 0.175 mm width.



(2) Character composition

The thermal head is fed $1/360''$ (0.0706 mm) for each step of the carriage motor. Heating takes place every other step. Thirty-six steps equal one character pitch. The first two and the last two steps each become spaces, and the character is composed of 16 horizontal by 23 vertical dots.

There are no spaces with underlines and they are of an 18-dot horizontal composition.

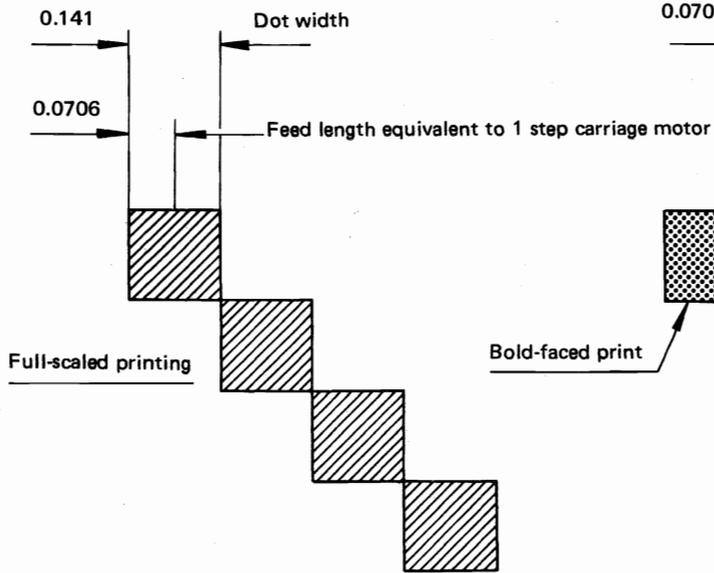
In the EXP (expanded) mode, the character pitch is of 72 steps. The first and last four steps each become spaces, and the character is composed of 32 horizontal by 23 vertical dots.

Boldface type can be obtained in the BOLD mode.

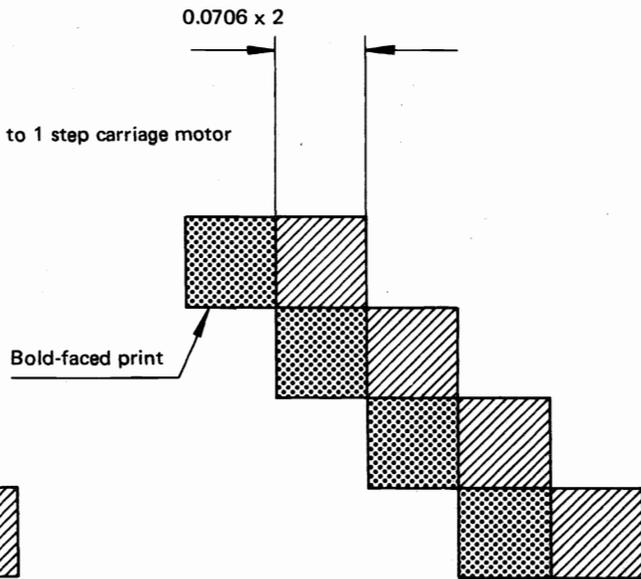
(Boldface type is not available in the EXP mode.)

In boldface type, each dot is printed twice with two-step intervals.

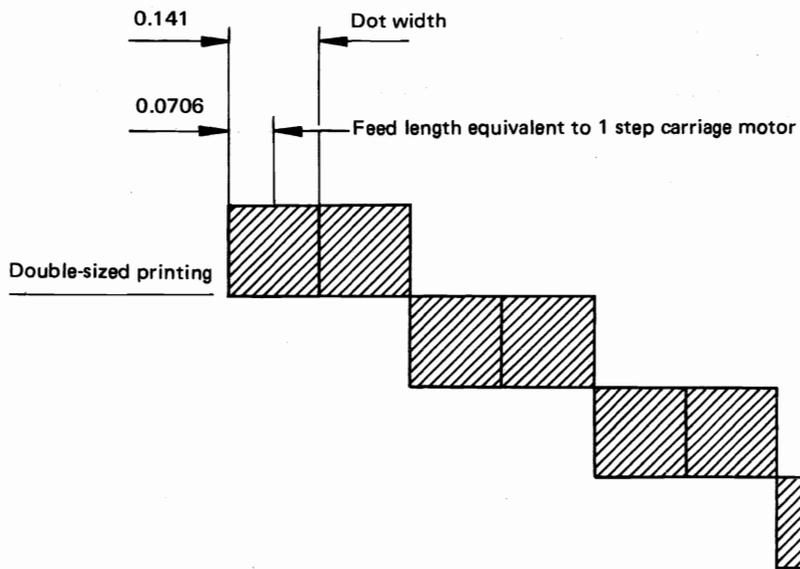
Normal character



Boldface character



Normal character



1.2 Ribbon Feed Mechanism

1.2.1 Movement

- (1) With forward movement of the carriage, the oscillating gear, which is engaged with the teeth on the rack, revolves clockwise.
- (2) The revolution of the oscillating gear is transmitted to the slip gear.
- (3) The slip gear is pushed downward by the coil spring to transmit its revolution to the cam shaft through the felt.

The design of the slip gear is such that its revolution is faster in respect to the cam shaft, and therefore, normally slips with respect to the felt. The rate of this slipping increases with an increase in the amount of ribbon wound.

- (4) The ribbon feed cam attached to the cam shaft is engaged with the spool inside the ribbon cassette case and winds the ribbon counterclockwise.

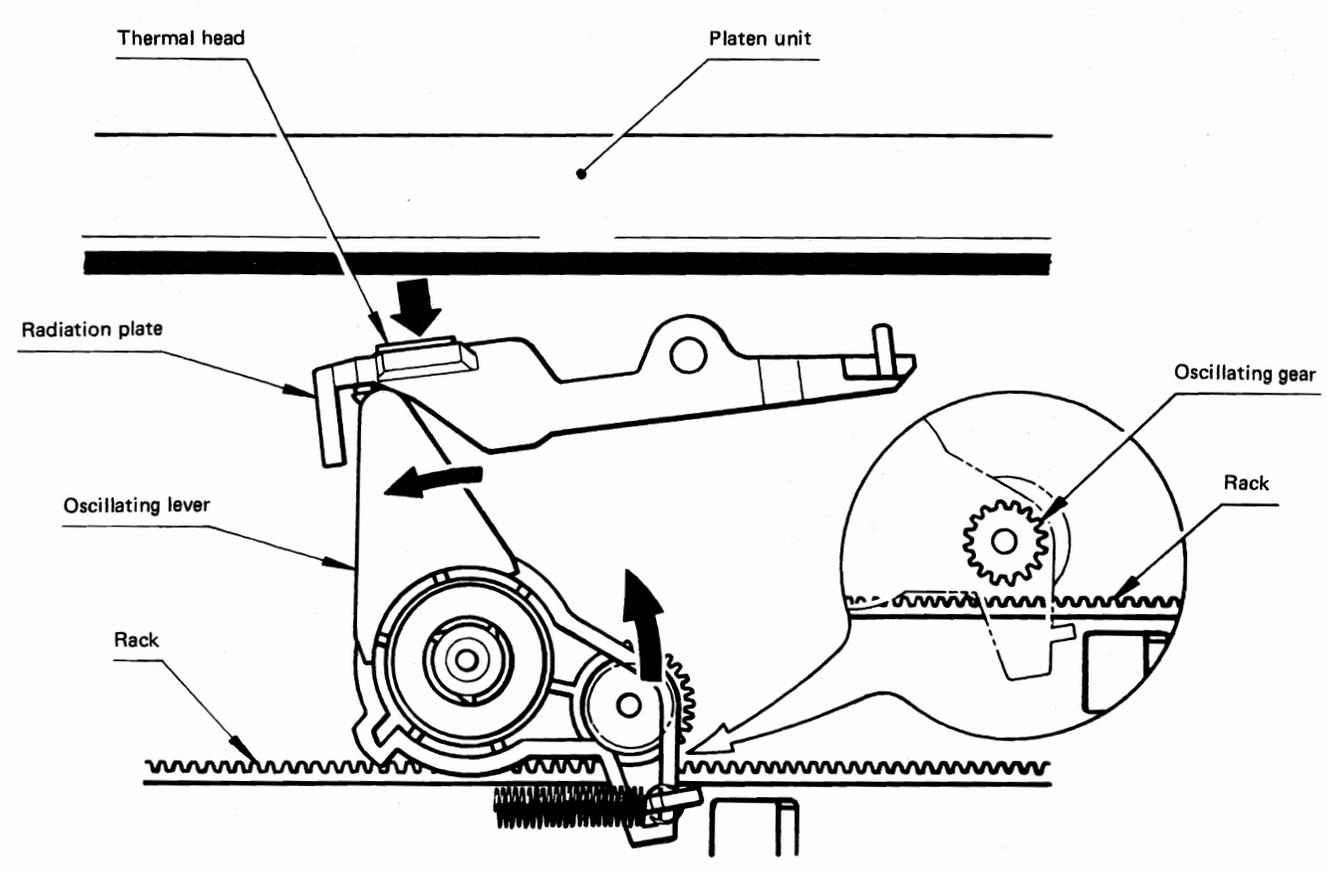
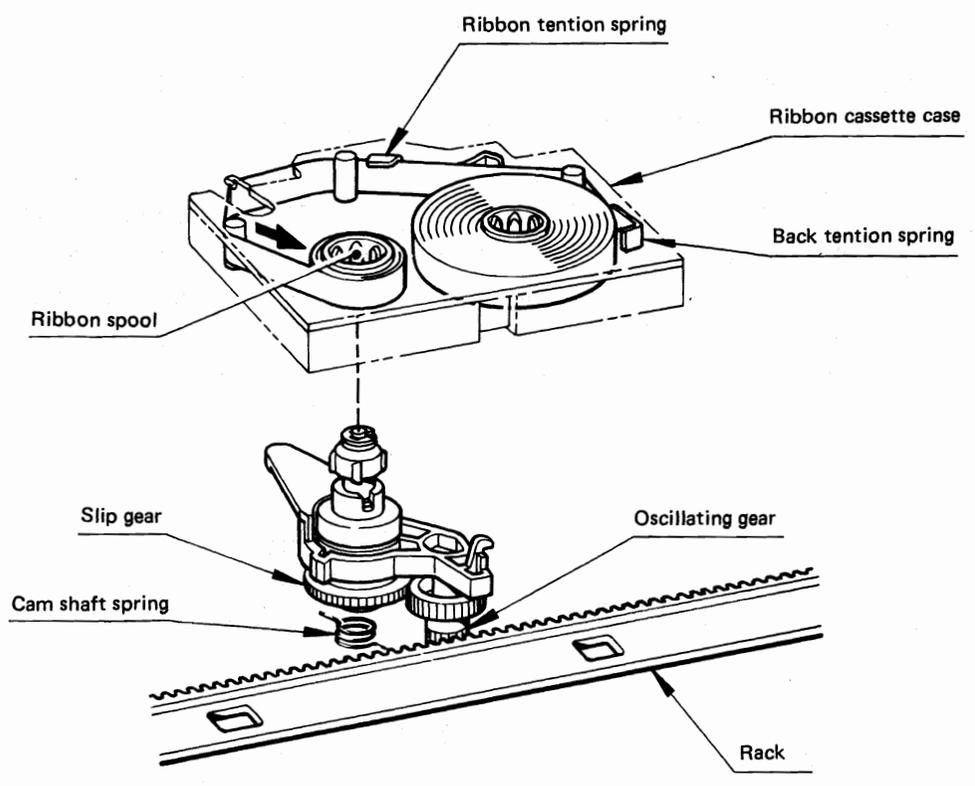
When the thermal head is released and moves away from the platen, the radiation plate pushes in the oscillating lever, disengaging the oscillating gear and rack, and the oscillating gear stops revolving.

1.2.2 Why the ribbon moves

The ribbon spool winds the ribbon, but the friction between the paper and the ribbon, which is greater than that between the ribbon and the head, is the actual source of the energy feeding the ribbon.

1.2.3 Ribbon slack prevention mechanism

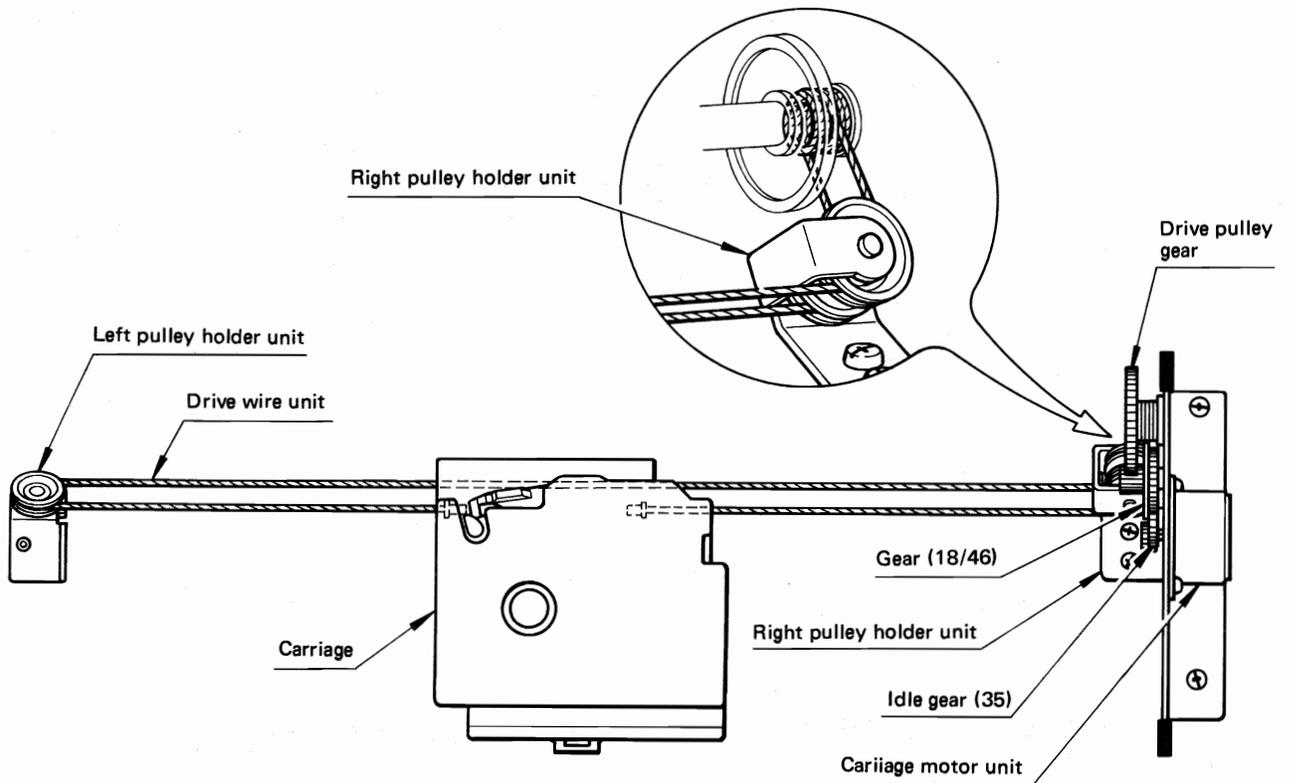
The cam shaft spring is located at the drive side of the ribbon feed mechanism. In combination with this spring, the ribbon tension spring and back tension spring, slack in the ribbon is prevented.



1.3 Carriage Movement Mechanism

1.3.1 Operation

- (1) The carriage motor's revolution is transmitted to the drive pulley gear through the idle gear (35) and the gear (18/46).
- (2) Wound around the drive pulley gear is the drive wire, and because the carriage is fixed to it, it causes the carriage to move along with the revolution of the drive pulley gear, guided by the frame and carriage guide bar.



1.3.2 Carriage travel speed

- (1) Printing: Approx. 13 cps
- (2) Return: Approx. 28 cps

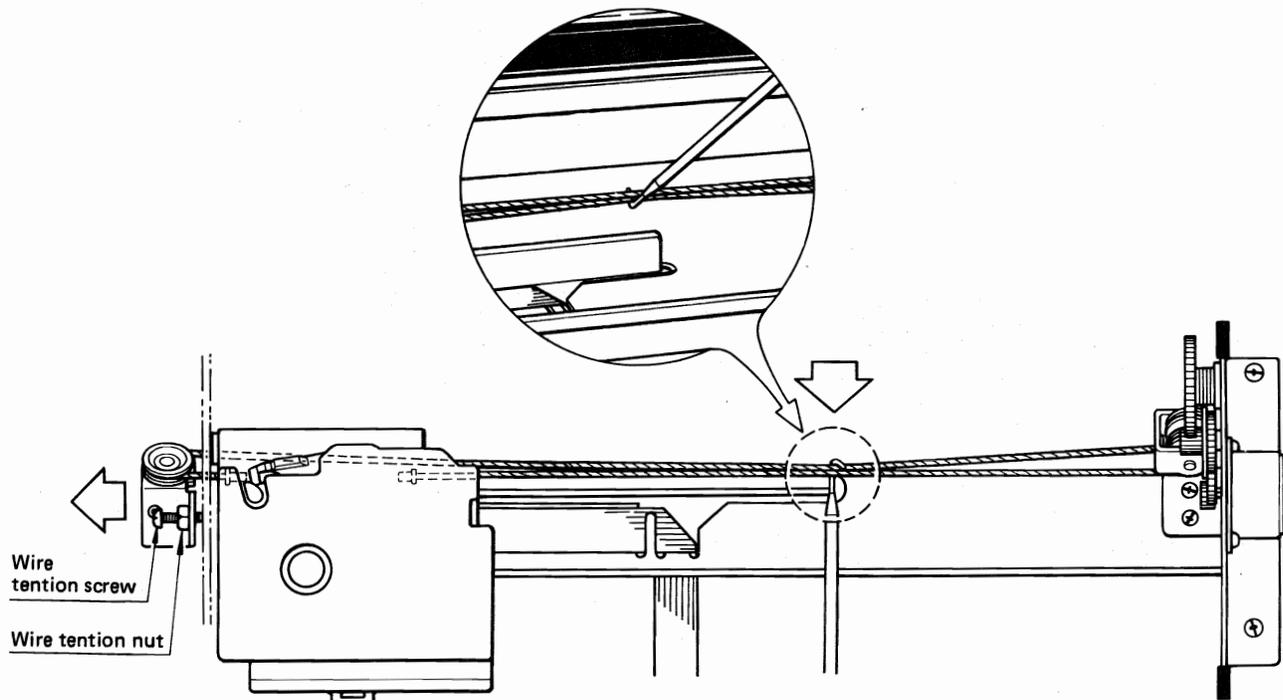
1.3.3 Carriage drive wire tension

The left pulley holder unit is installed at the left side of the frame. The left end of the drive wire is looped around the idle pulley.

The tension of the drive wire is adjusted by means of the wire tension screw, which positions the left pulley holder unit. The wire tension should be adjusted as follows

- (1) Remove the upper and lower covers.

- (2) Move the carriage to the far left until it touches the left frame edge. Pull up the lower drive wire to bring it into contact with the upper drive wire, as shown in figure. Check to see if the tension is at 90 to 110 g. If adjustment is required, loosen the wire tension nut and readjust by turning the wire tension screw. Then, retighten the nut.



1.4 Paper Feed Mechanism

1.4.1 Operation

Paper feed is accomplished by the paper feed roller, which by means of the spring pin, is attached to, and revolves with, the paper feed gear. The paper feed motor revolves the paper feed gear through gears (30) and (15/66). The operation of the PAPER UP and PAPER DOWN function keys causes the paper feed motor to revolve either forward or in reverse, thus feeding the paper either up or down.

1.4.2 Selection of paper feed rate

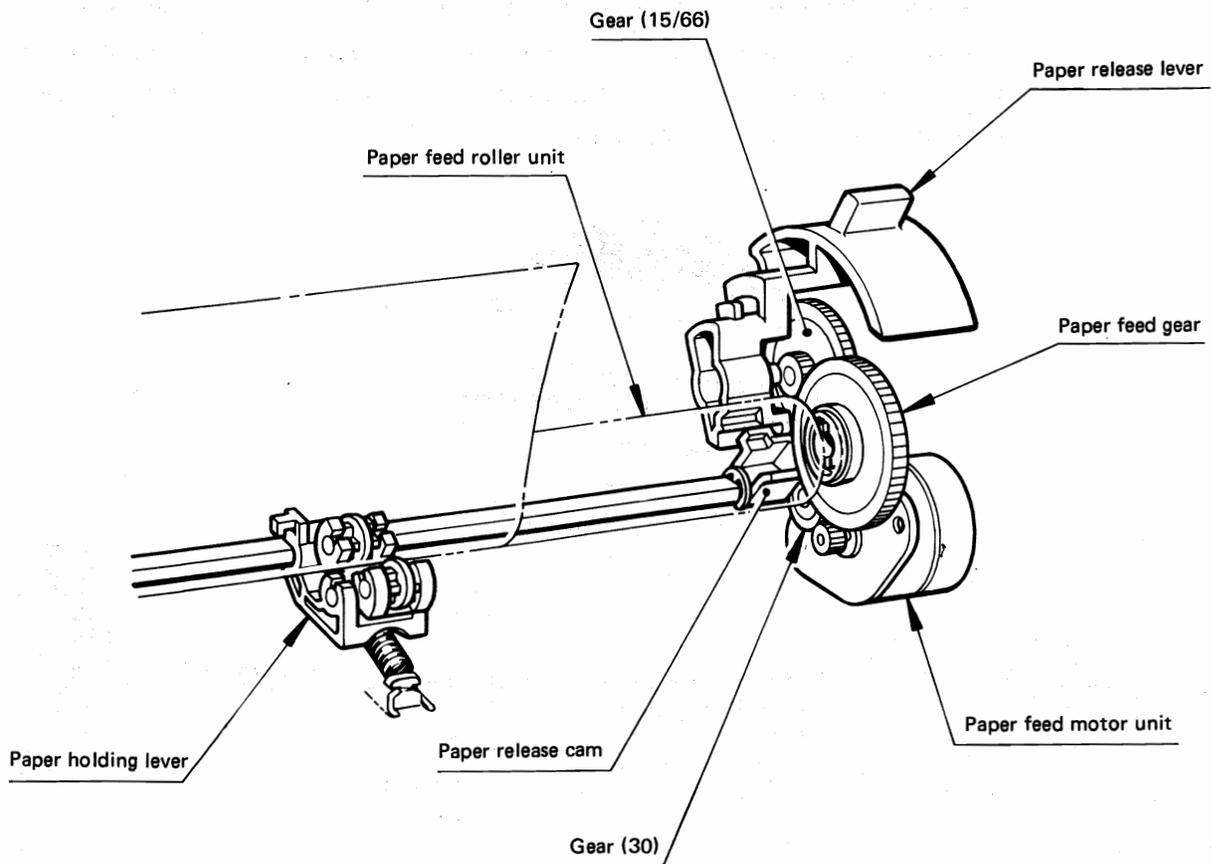
The amount of paper fed for each operation of the return key can be selected using the slide switch.

The following three levels are available

1	4.233 mm	(1/6")
1-1/2	6.350 mm	(1/4")
2	8.467 mm	(1/3")



The amount of paper fed for each operation of the function keys (PAPER UP and PAPER DOWN) is 2.117 mm (1/12").



1.5 Thermal Head Operating Mechanism

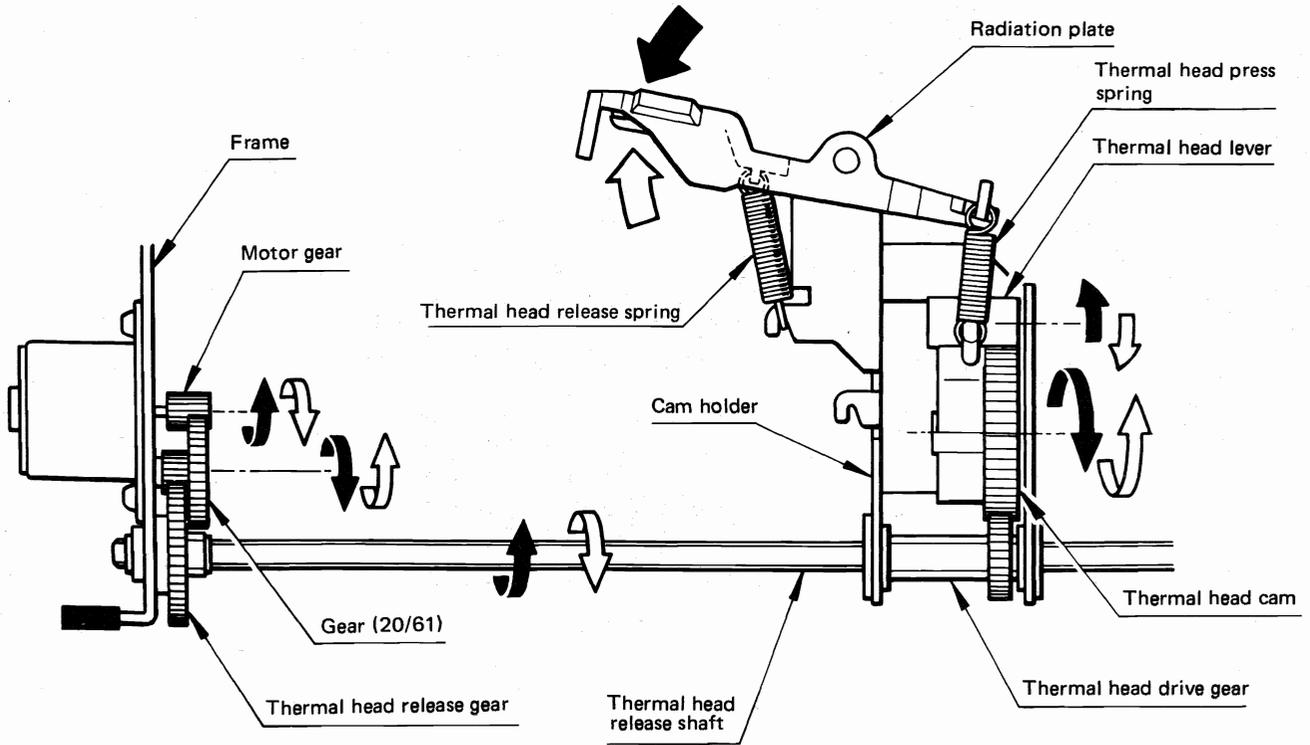
The thermal head motor, through gears and cams, controls head movement.

1.5.1 When a print signal is received

- (1) When current is passed to the thermal head motor, the motor gear, as seen from the frame's right, revolves counterclockwise. Through the gear (20/61), the thermal head release gear, release shaft and drive gear, the head cam revolve clockwise as seen from the frame's right.
- (2) The thermal head cam revolves clockwise, causing the head lever to move forward, and by means of the thermal head press spring attached to the head lever, the radiation plate moves toward the platen.

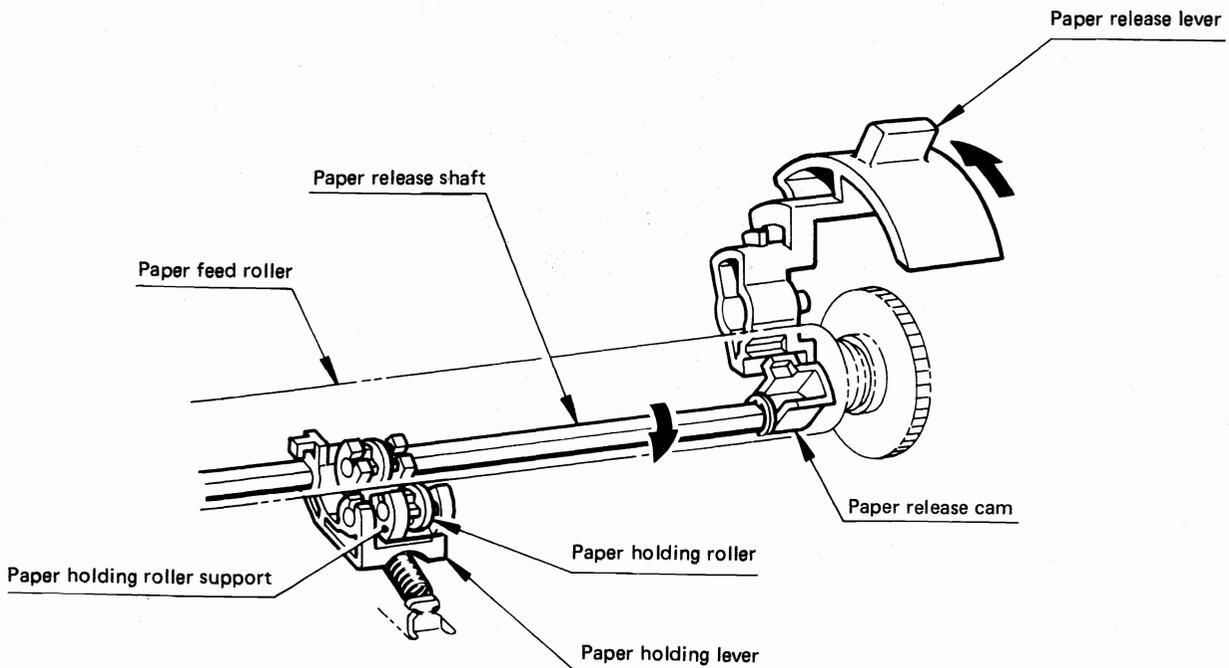
1.5.2 When printing is completed

- (1) The thermal head motor revolves clockwise and the head cam revolve counterclockwise, as seen from the frame's right.
- (2) Due to thermal head cam revolution, the head lever, assisted by the force of the head release spring, causes the radiation plate to be pulled forward, away from the platen.

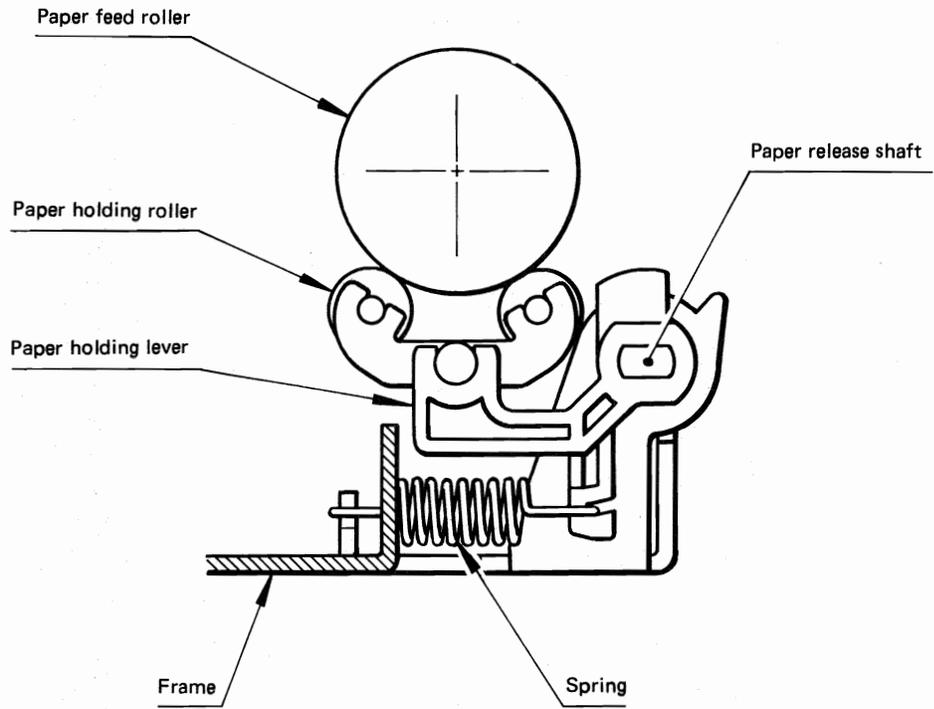


1.6 Paper Release Mechanism

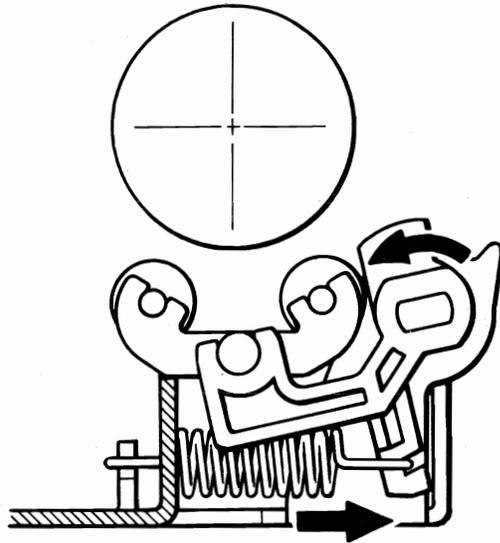
By pushing the paper release lever from the forward position to the rear, the paper release cam is enacted, and the paper release shaft revolves. The paper holding lever is pushed downward by the paper release shaft, and a gap is formed between the paper holding rollers and the paper feed roller, thus freeing the paper.



Paper pressed down



Paper released

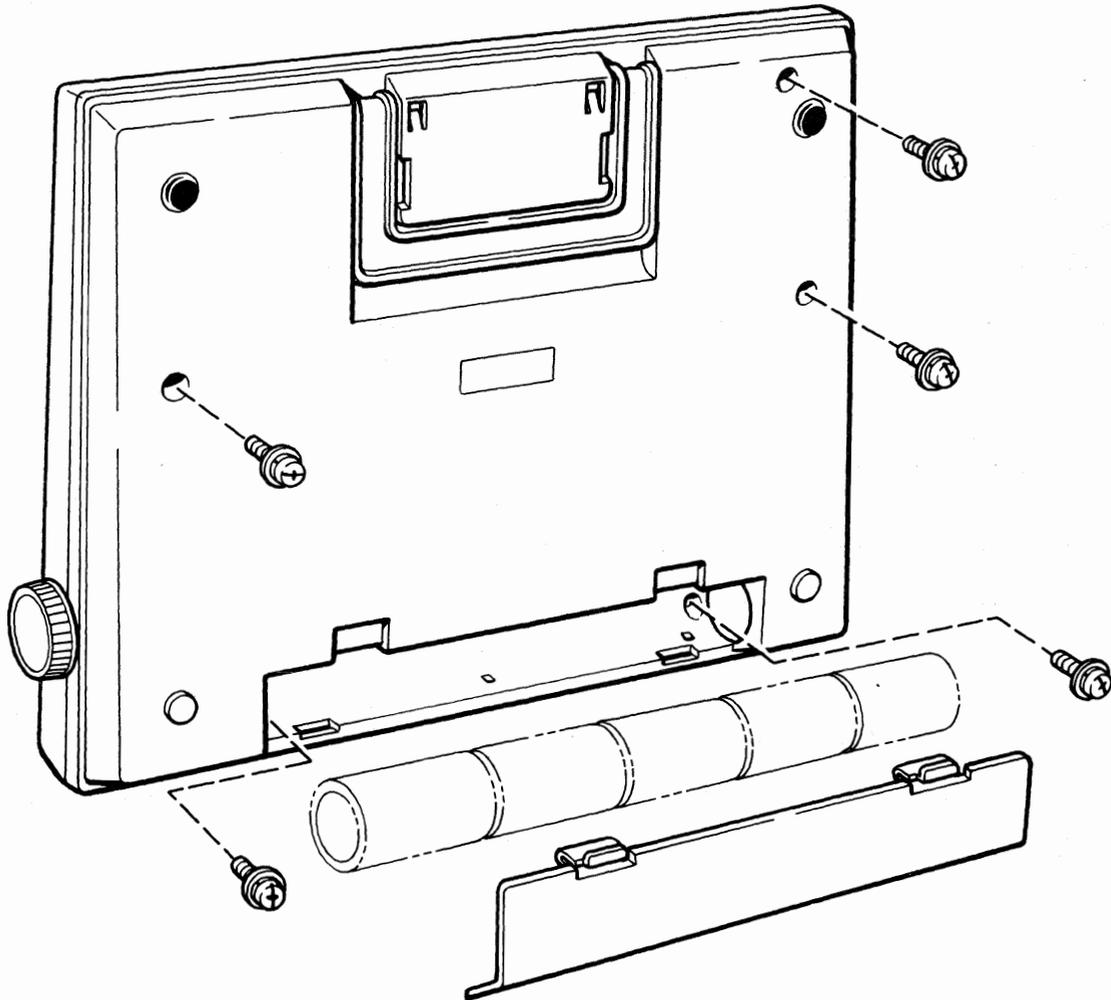


CHAPTER II. DISASSEMBLY AND REASSEMBLY

1. DISASSEMBLY

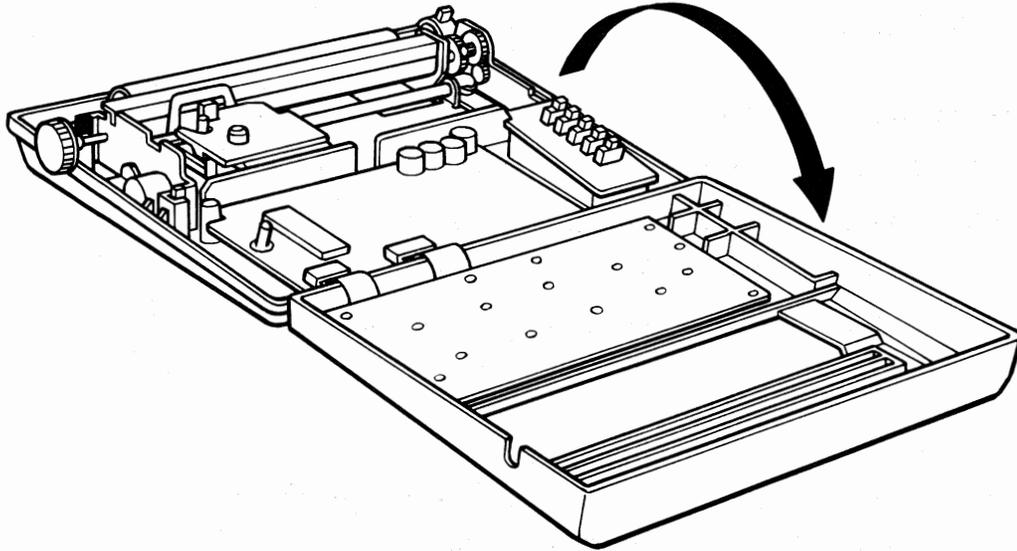
1.1 Removing the Upper Cover

- (1) Turn the machine over. Remove the battery lid and batteries.
- (2) Remove the five screws securing the lower cover.
- (3) Replace the machine upright.
- (4) Remove the upper cover and place it down in front of the machine.



1.2 Removing the Driver PCB and the Shield Plate

- (1) Lift off the upper cover and place it down in front of the machine.



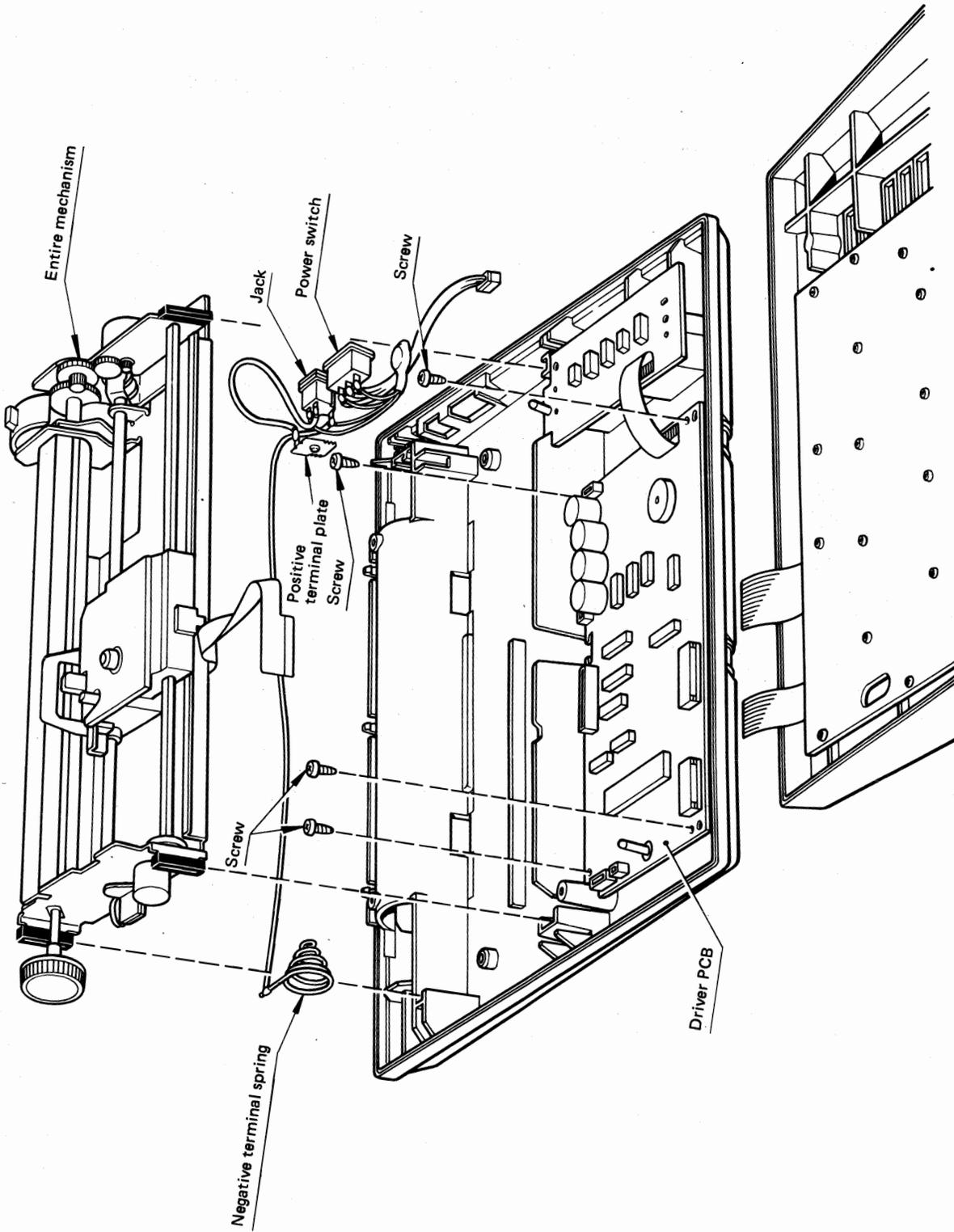
- (2) Disconnect all connectors for the flexible cable, thermal head motor, carriage motor, paper feed motor, and the leaf and power switches.
- (3) Disconnect the pattern films.
- (4) Lift out the driver PCB by removing the five screws holding it.
- (5) Detach the shield plate by removing the five screws holding it.

1.3 Removing the Entire Mechanism

- (1) Detach the flexible cable from the ribs holding it to the lower cover.
- (2) Detach the power switch unit.
- (3) The entire mechanism can then be removed.

1.4 Removing the Power Switch

- (1) Slide out and upwards the positive terminal plate and the negative terminal spring.
- (2) Slide out and upwards the power switch and jack.

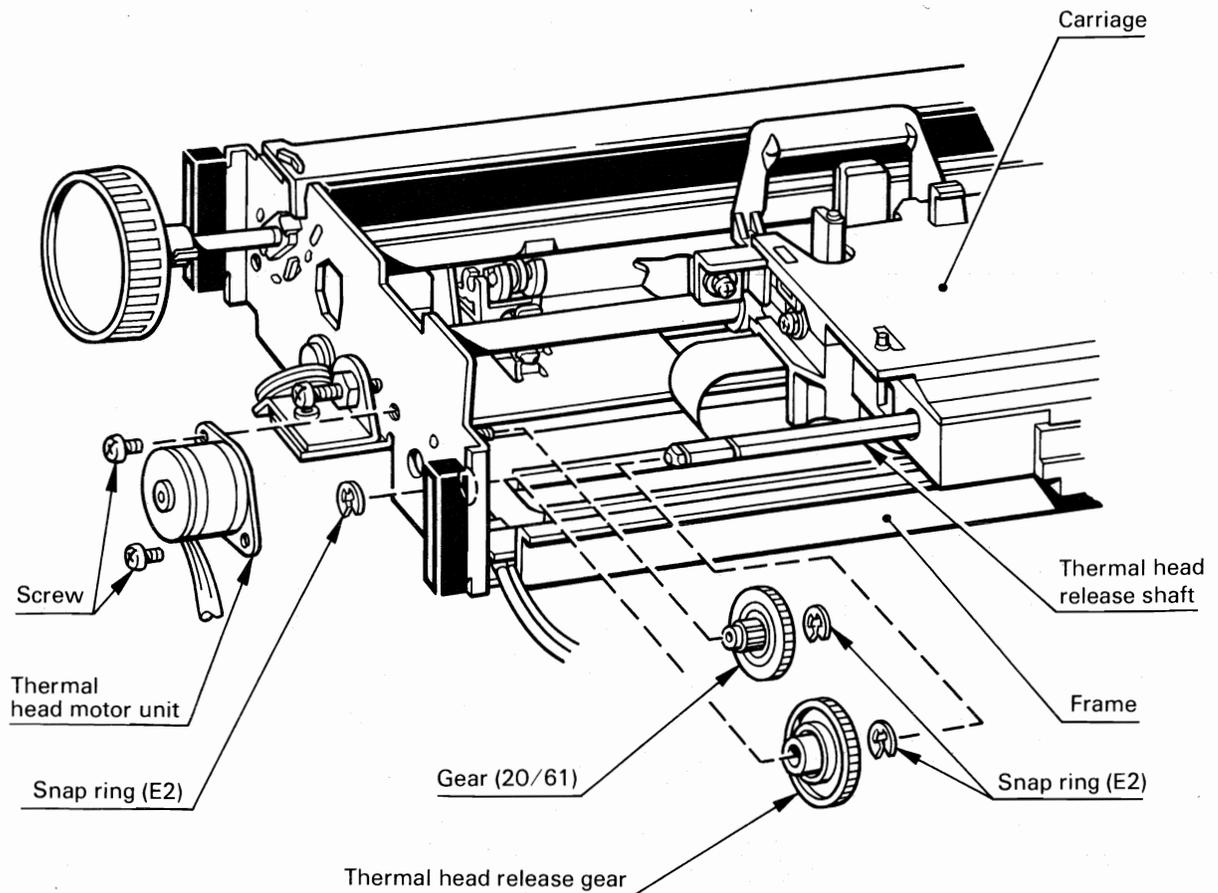


2. DISASSEMBLY OF THE MECHANISM

2.1 Disassembly of the Entire Mechanical Section

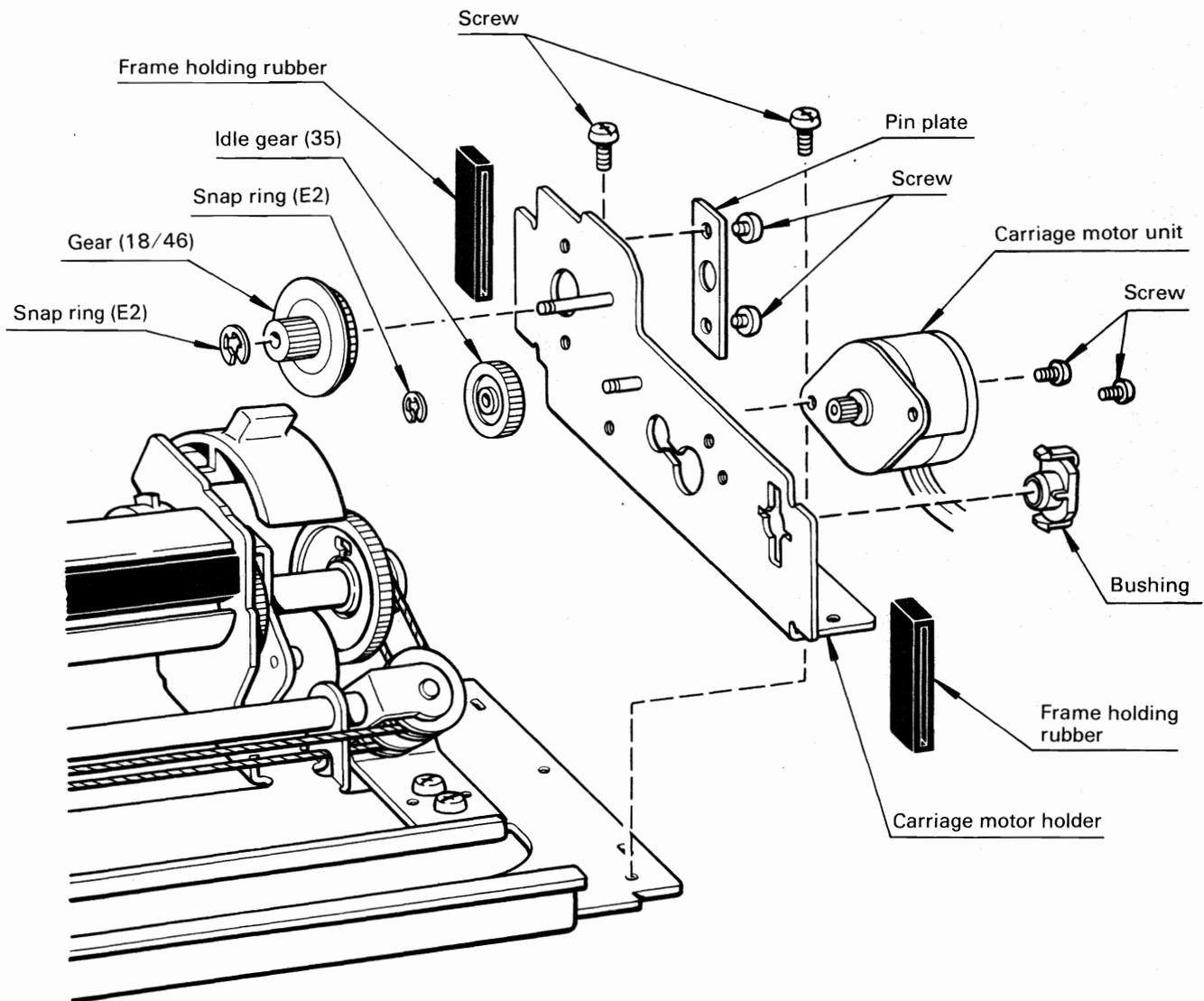
2.1.1 Disassembly of chassis related parts

- (1) Detach the thermal head motor unit by removing the two screws holding it.
- (2) Detach the gear (20/61) by removing the snap ring (E2).
- (3) Detach the thermal head release gear by removing the two snap rings (E2).
- (4) Remove the thermal head release shaft from the carriage and frame.



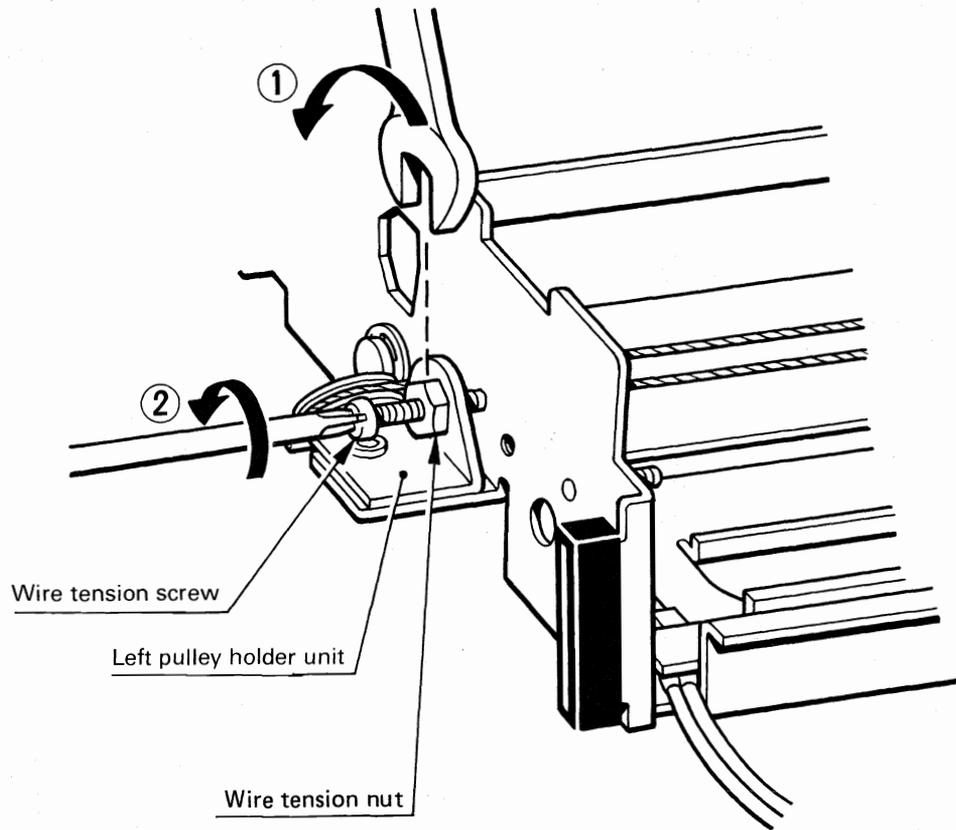
2.1.2 Disassembly of the carriage motor holder unit

- (1) Detach the pin plate by removing the two screws holding it.
- (2) Detach the carriage motor holder unit by removing the two screws holding it.
- (3) The carriage motor unit can then be detached by removing the two screws holding it.
- (4) Detach the idle gear (35) by removing the snap ring (E2).
- (5) Detach the gear (18/46) by removing the snap ring (E2).
- (6) Slide off the two frame holding rubbers out of the carriage motor holder.

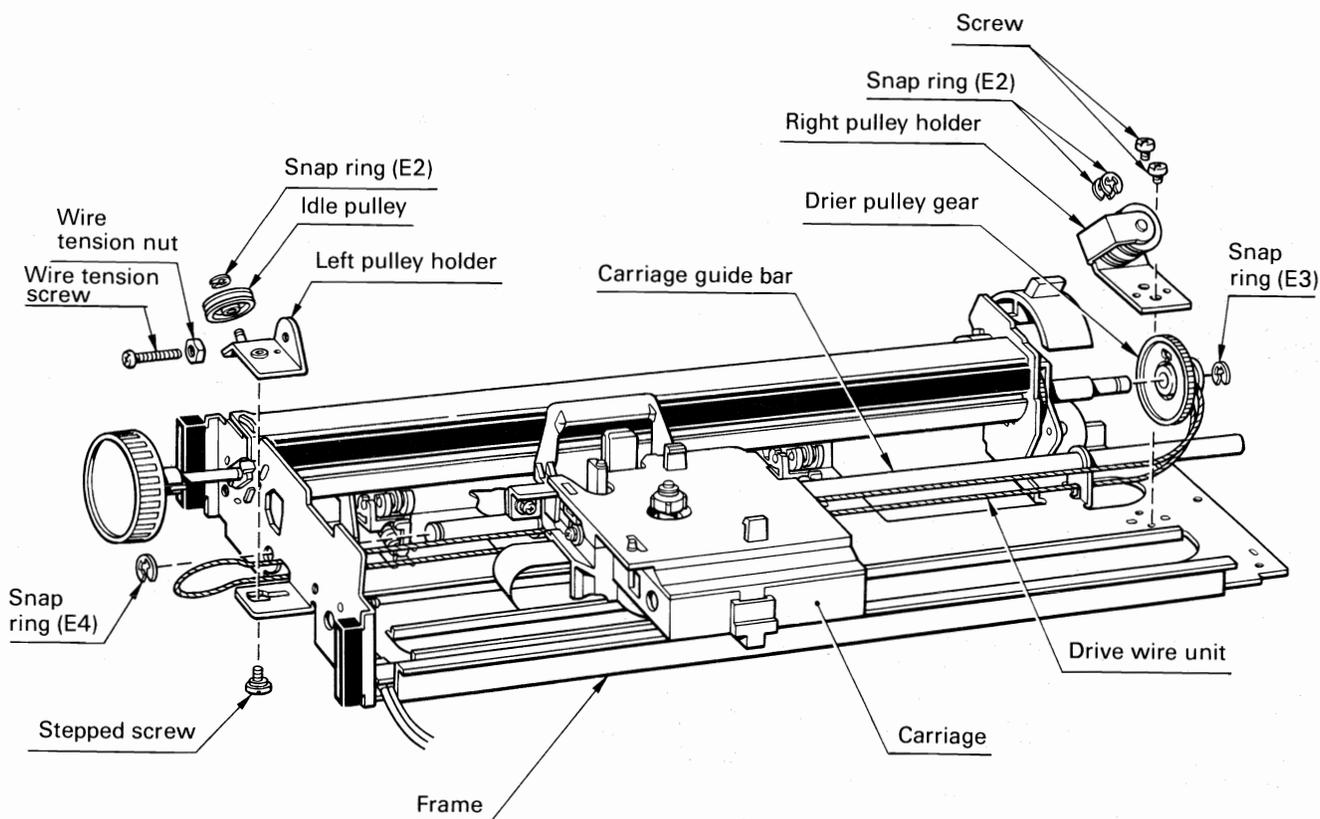


2.1.3 Disassembly of other chassis related parts

- (1) Loosening the wire tension nut and screw to give the left pulley holder unit free play.

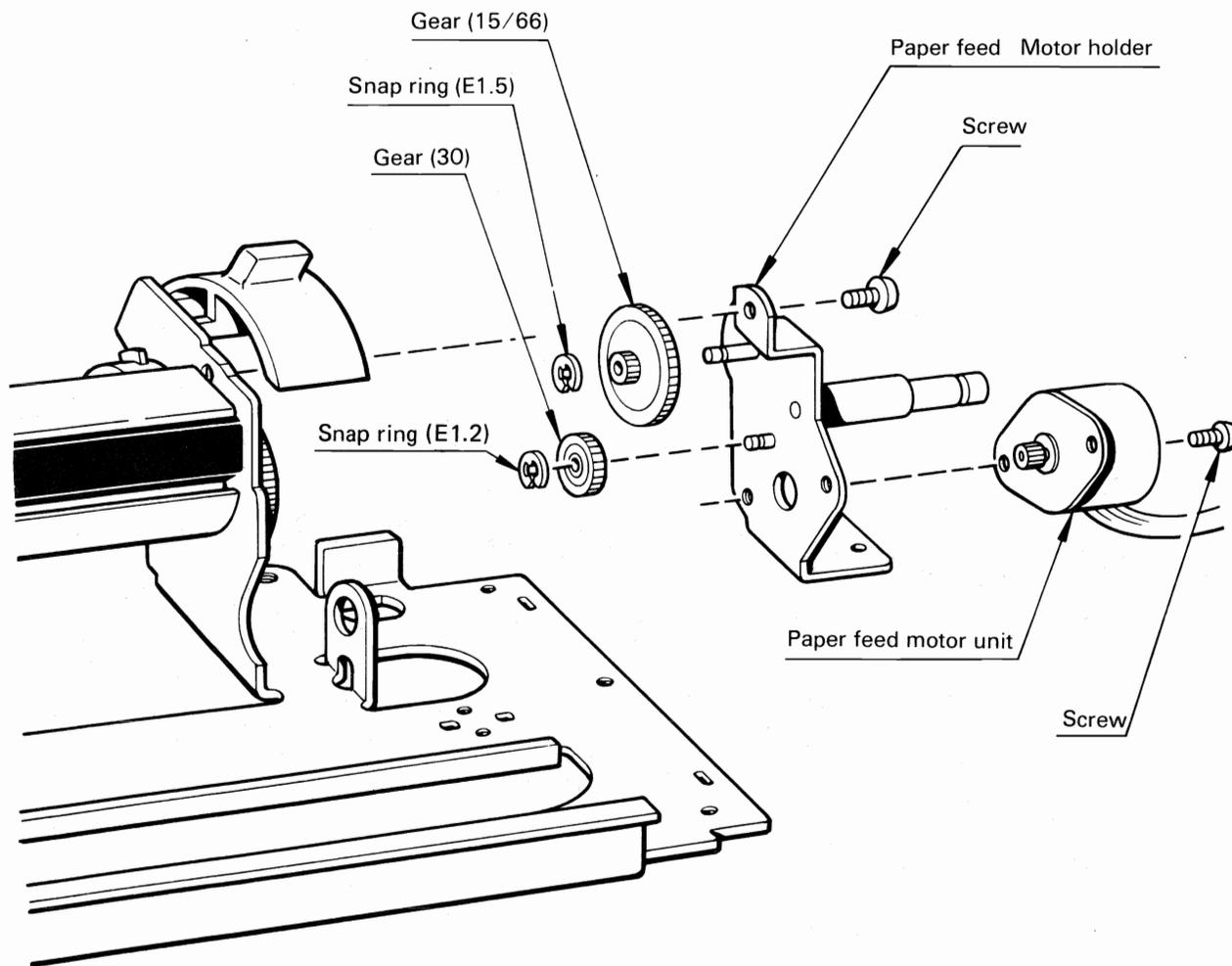


- (2) Remove the stepped screw, snap ring (E2), and the idle pulley to disassemble the left pulley holder unit.
- (3) Remove the two screws and the two snap rings (E2) to disassemble the right pulley holder unit.
- (4) Detach the drive pulley gear (includes drive pulley shaft and drive wire unit) from the pin plate by removing the snap ring (E3).
- (5) Detach the carriage guide bar from the carriage and frame by removing the snap ring (E4).



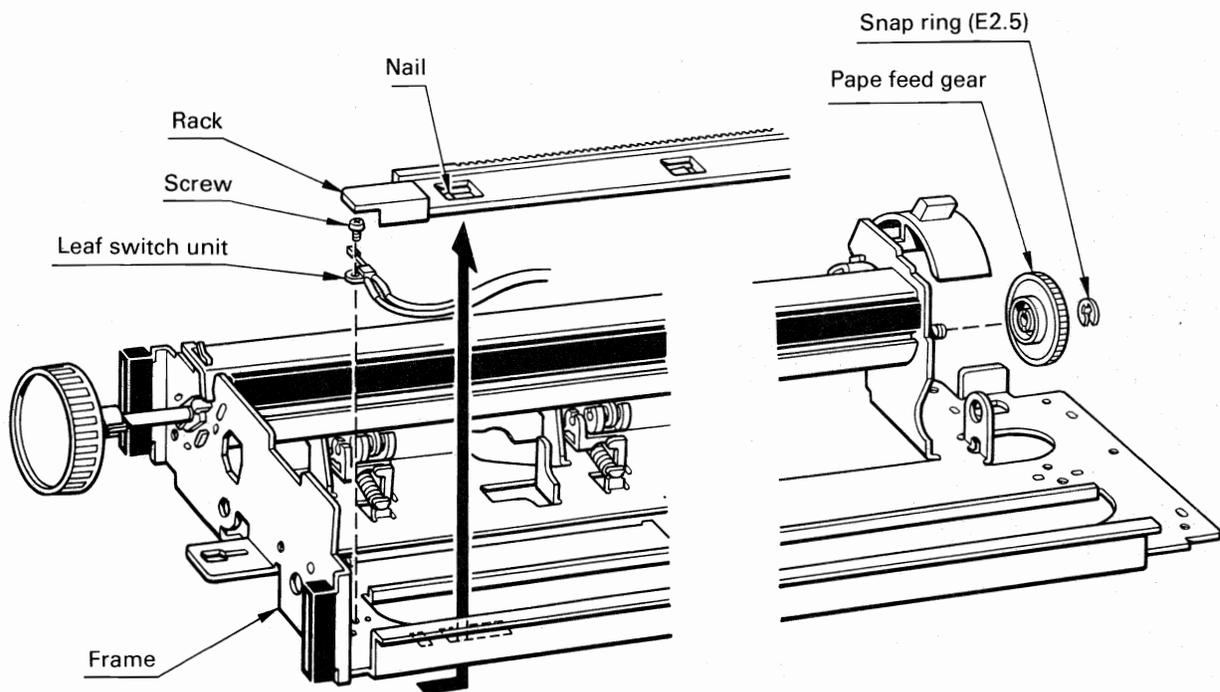
2.1.4 Disassembly of the paper feed motor holder unit

- (1) Remove the two retaining screws from the paper feed motor holder unit.
- (2) Remove the two retaining screws from the paper feed motor unit.
- (3) Remove the snap ring (E1.2) from the gear (30).
- (4) Remove the snap ring (E1.5) from the gear (15/66).

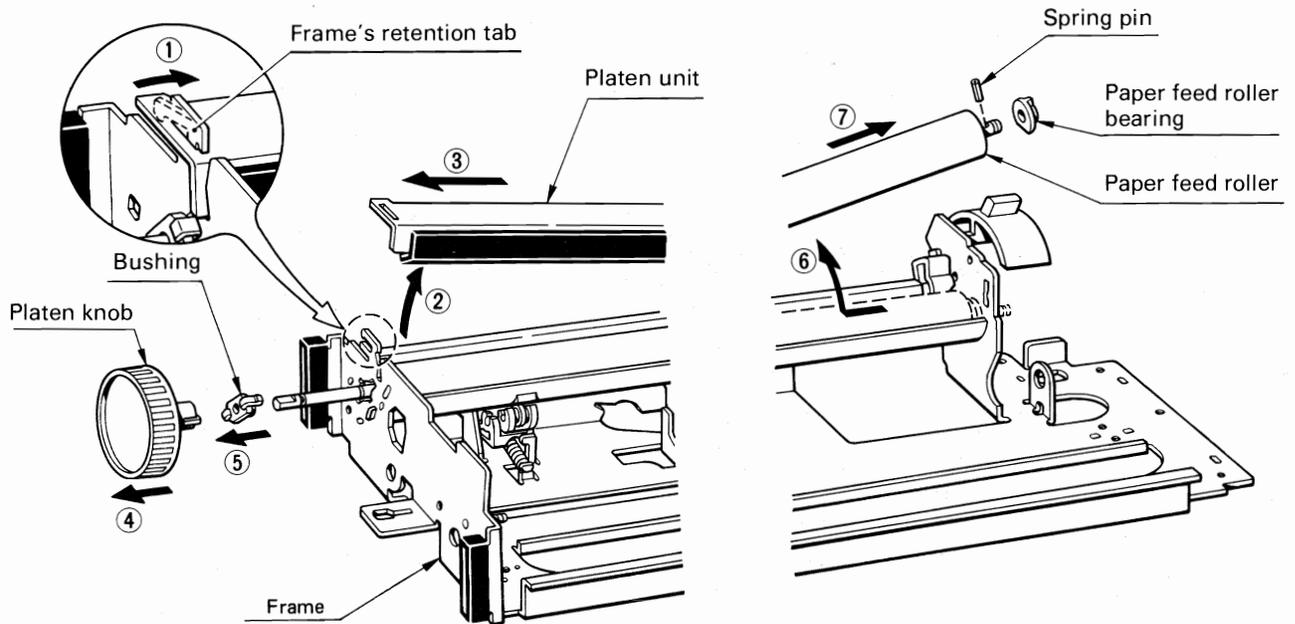


2.1.5 Disassembly of the chassis section

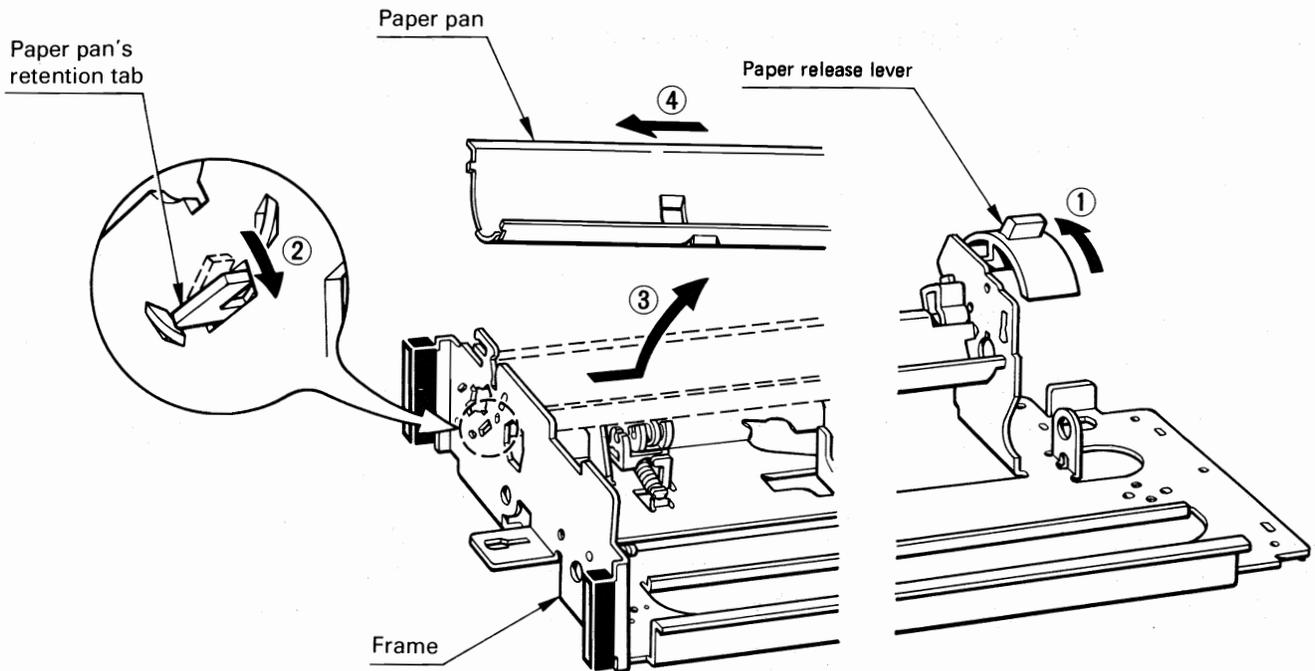
- (1) Slide the rack to the right so that it is free from the retaining tabs and pull it away from the frame.
- (2) Detach the leaf switch unit by removing the retaining screw.
- (3) Remove the paper feed gear by removing the snap ring (E2.5).



- (4) To remove the platen, use pliers to restraighten the frame's retention tab. Then, while lifting it up, move it to the left and away from the frame.
- (5) Pull off the platen knob from the paper feed roller unit. Then, detach the bushing from the frame and paper feed roller unit. Slide the roller unit to the left while simultaneously lifting the right side of the unit to free it from the frame.
- (6) To disassemble the paper feed roller unit, pull out the spring pin and remove the paper feed roller bearing.

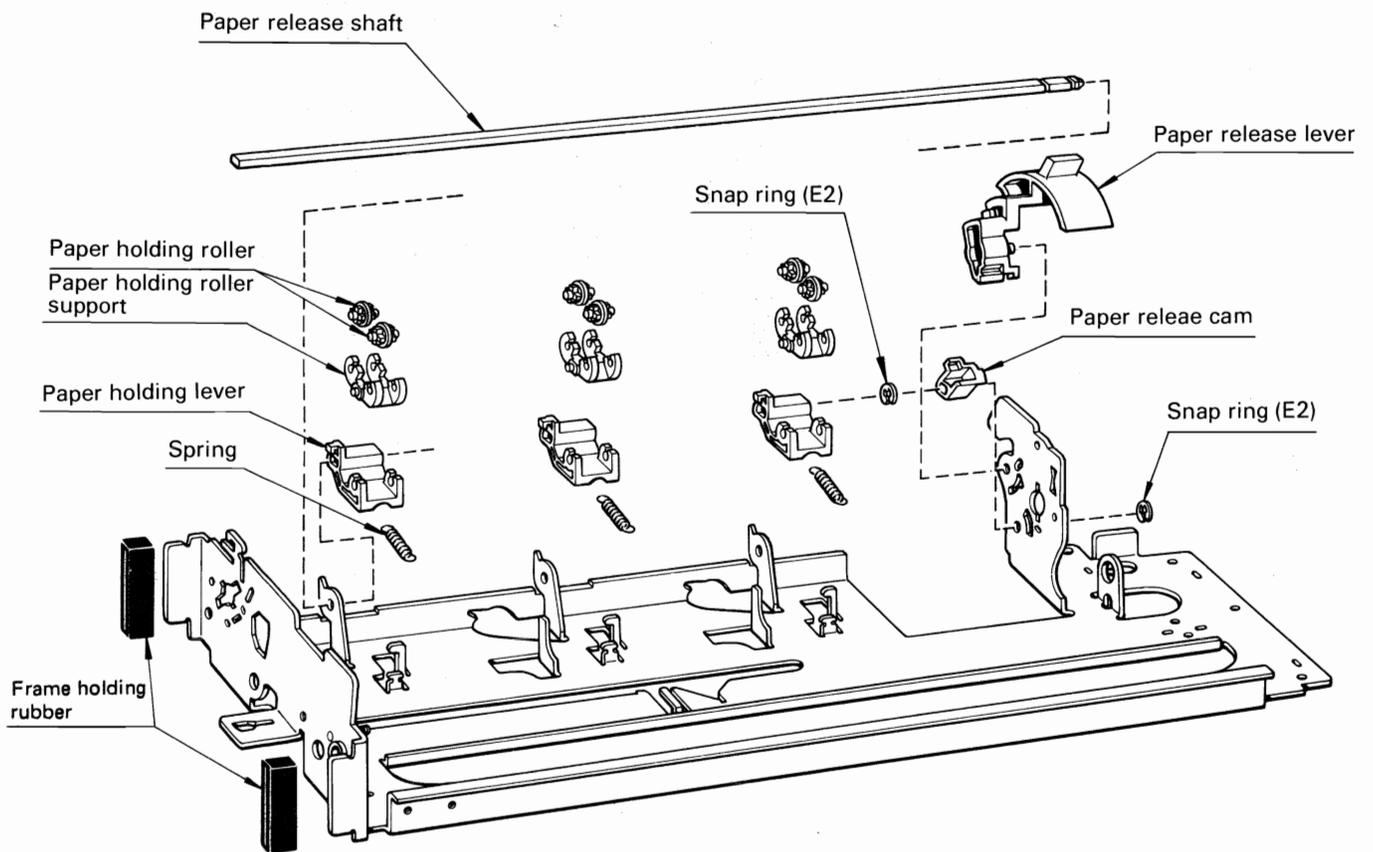


- (7) Restraighten the paper pan's retention tab. With the paper release lever pushed back, move the paper pan slightly to the right while simultaneously lifting the left end of the paper pan up and away from the frame.



2.1.6 Disassembly of the frame section

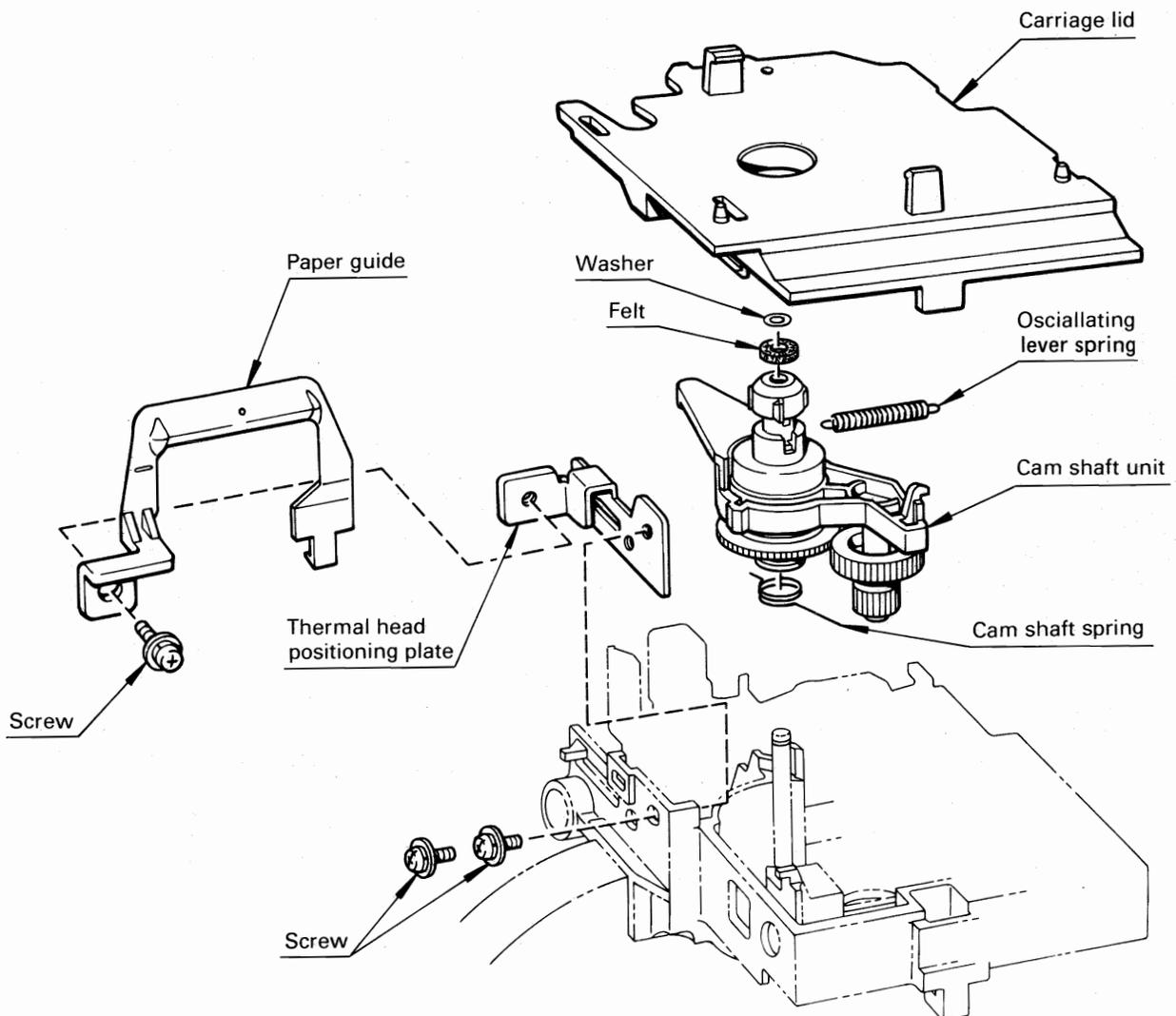
- (1) Remove the three springs from the frame.
- (2) Detach the paper release cam by removing the two snap rings (E2).
- (3) From the left side, pull out the paper release shaft from the frame.
- (4) Detach the paper release lever from the frame.
- (5) Remove the three paper holding lever from the frame.
- (6) From the paper holding lever, remove the three roller supports and then their six rollers.
- (7) Slide off the two frame holding rubbers out of the frame.



2.1.7 Disassembly of the carriage unit

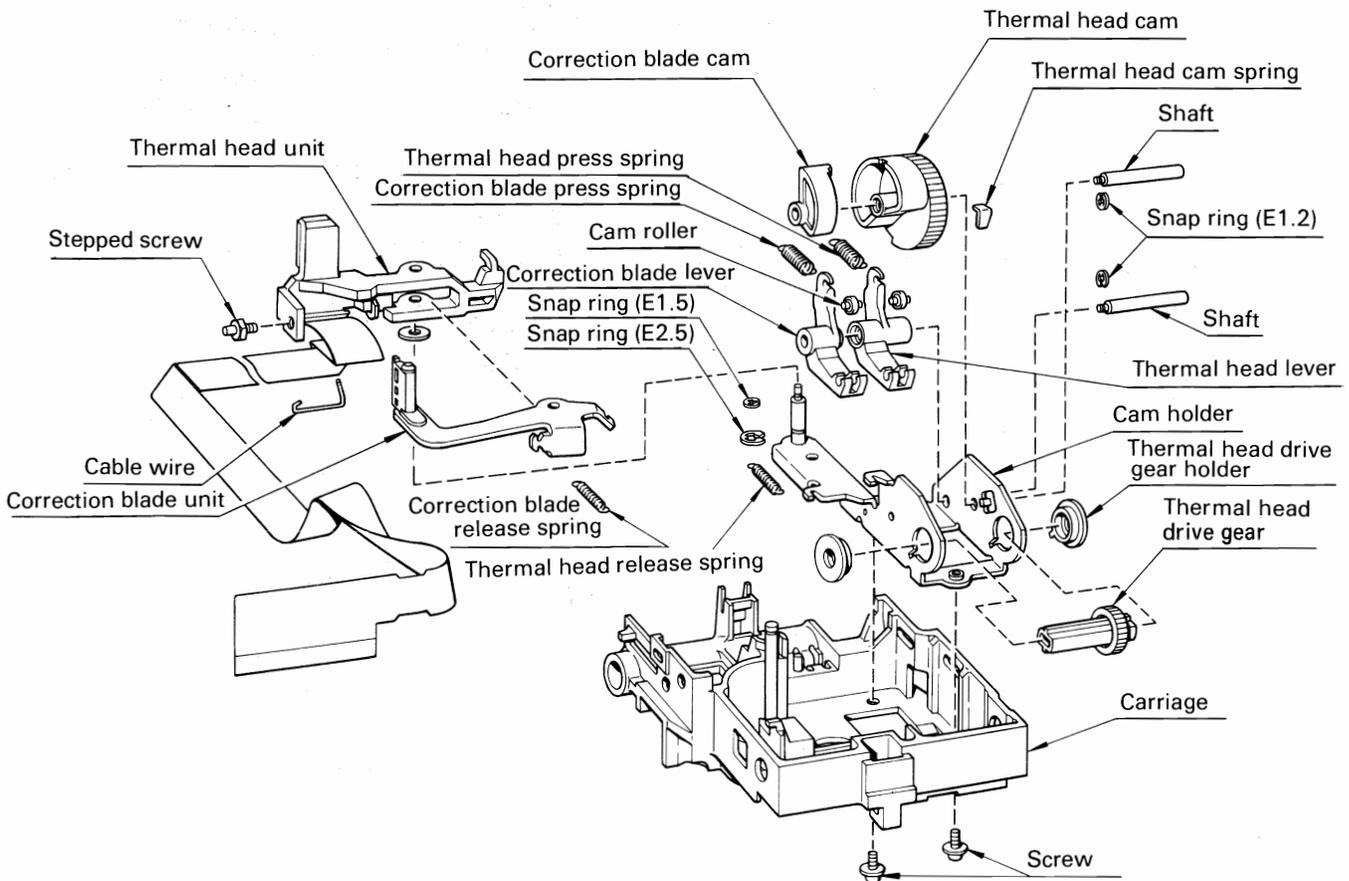
Carriage section

- (1) Remove the carriage lid.
- (2) Detach the paper guide by removing the screw holding it.
- (3) Remove the spring from the oscillating lever.
- (4) Remove the felt and press-fitted washer from the top of the ribbon feed cam to lift the cam shaft unit upwards. This allows the cam shaft spring to be removed at the same time.
- (5) Detach the thermal head positioning plate by removing the two screws holding it.



Thermal head section

- (1) Detach the cam holder by removing the two screws holding it.
- (2) The following springs are removed in this order:
 - Thermal head press spring
 - Correction blade press spring
 - Thermal head release spring
 - Correction blade release spring
- (3) Remove the two thermal head drive gear holders.
- (4) Remove the thermal head drive gear.
- (5) Detach the thermal head cam and correction blade cam by removing the snap ring (E1.2), and the shaft. Then, detach the spring from the thermal head cam.
- (6) Detach the thermal head lever and correction blade lever by removing the snap ring (E1.2), shaft. Then, detach the two cam rollers one each from the thermal head lever and the correction blade lever.
- (7) Detach the correction blade unit by removing the snap ring (E1.5).
- (8) Disassemble the head unit by first moving the snap ring (E2.5), and then pulling out the radiation plate washer. Next, detach the stepped screw and then the cable wire holding the flexible cable in place.



NOTE:

The thermal head unit itself incorporates the radiation plate and flexible cable.

3. REASSEMBLY

3.1 Reassembly

To reassemble, reverse the order of disassembly, with the exception of the items outlined in the following.

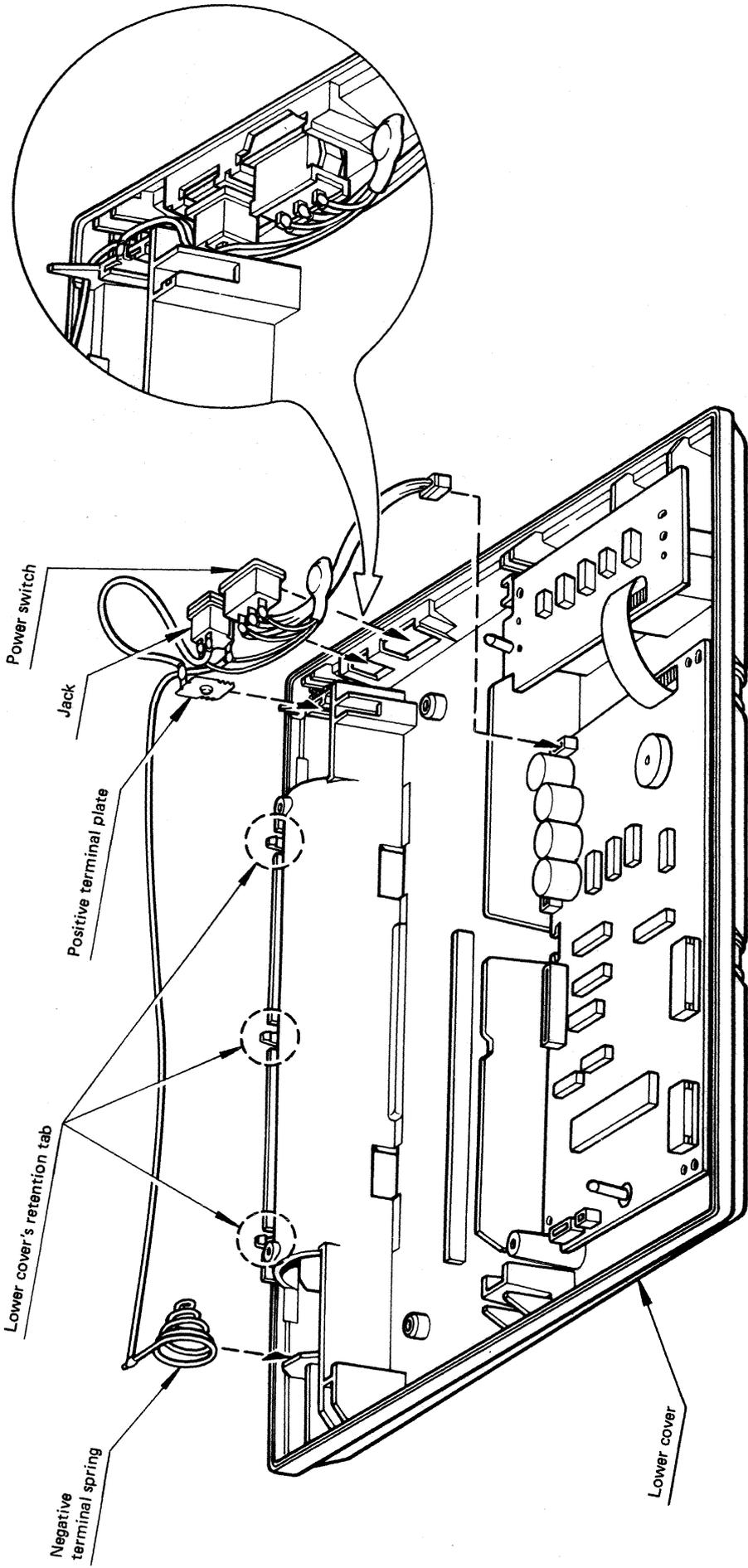
3.2 Reassembly of Electrical Parts

3.2.1 Reassembling the Power Switch

- (1) Insert into place the positive terminal plate, negative terminal spring, power jack, and power switch.
- (2) The lead wire for the negative terminal spring should be pushed into place under the three retention tabs provided on the lower cover.
- (3) The lead wires for both the positive terminal plate and negative terminal spring must be fitted into the notches of their receiving ribs in the lower cover.

NOTE:

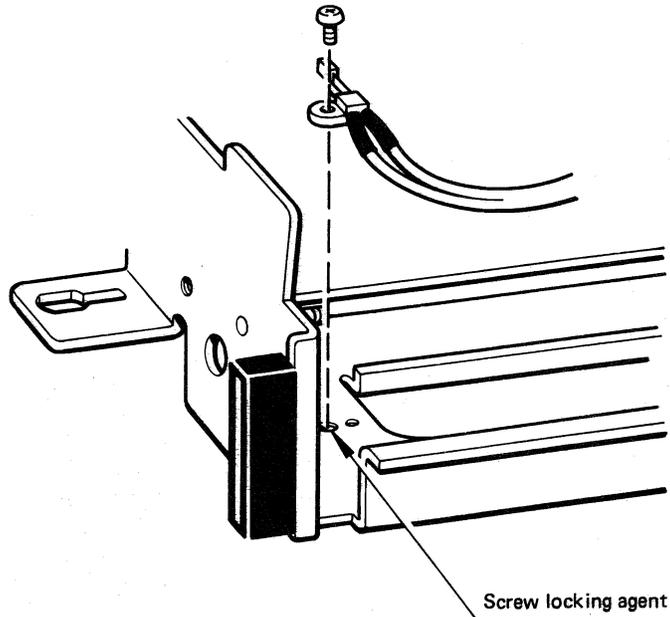
Care must be taken to prevent the lead wires from being pinched by the upper cover's rib which holds the power switch and the jack in place.



3.2.2 Reassembling the leaf switch unit

Apply a coating of screw locking agent (Three Bond 1401 or equivalent) to the screw hole for the leaf switch unit (home position detection). Affix the screw between a torque range of 0.6 and 0.8 Kgf-cm.

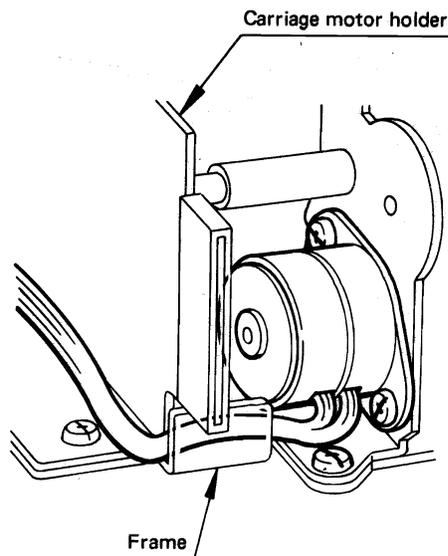
The torque required to loosen the screw after the agent has set should be from 0.4 to 1.0 Kgf-cm.



3.2.3 Reassembling the lead wires

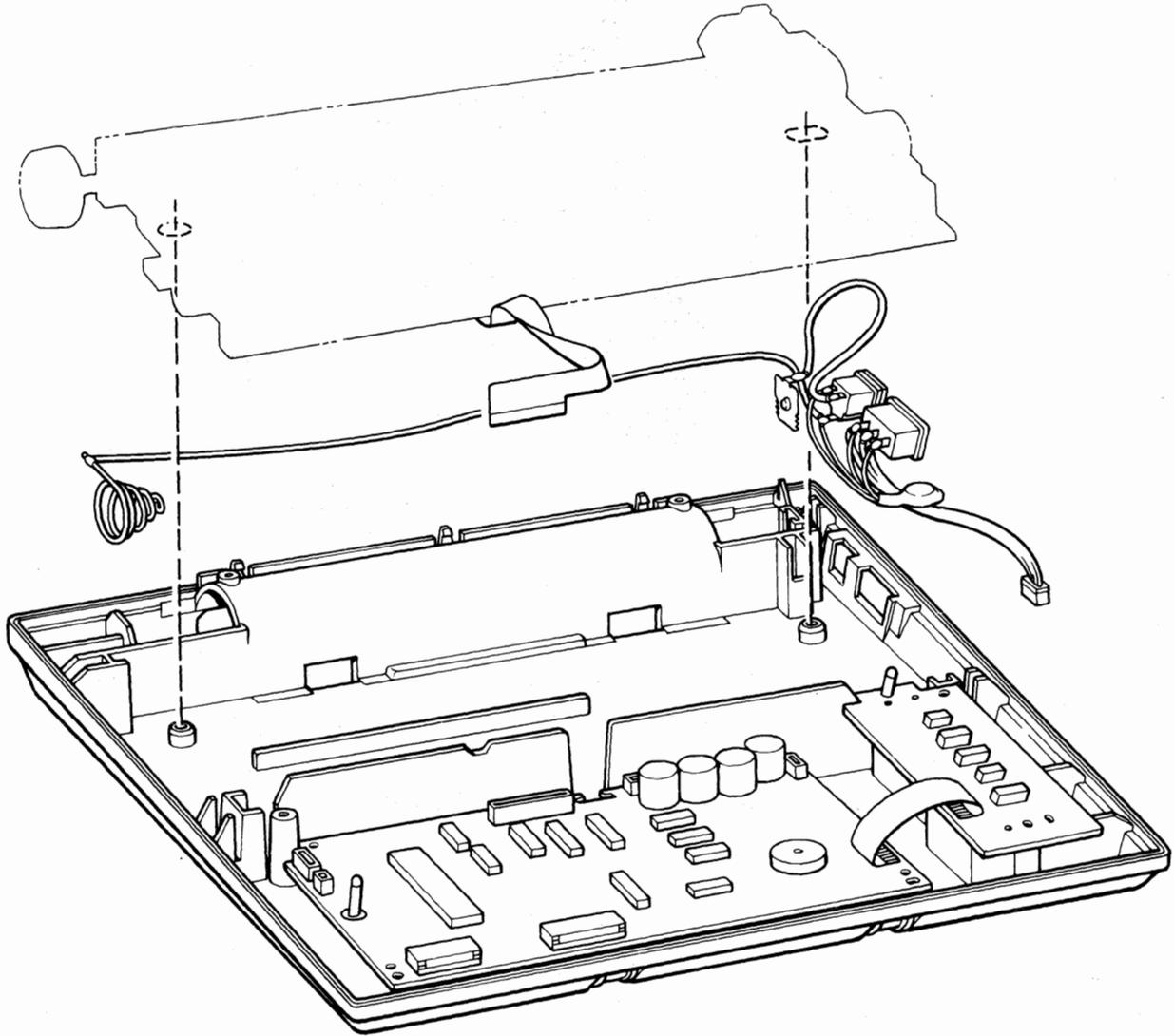
The lead wires for the paper feed motor should run between the frame and carriage motor holder, and set in place under the carriage motor as shown in figure.

Make sure they are not protruding from the frame.



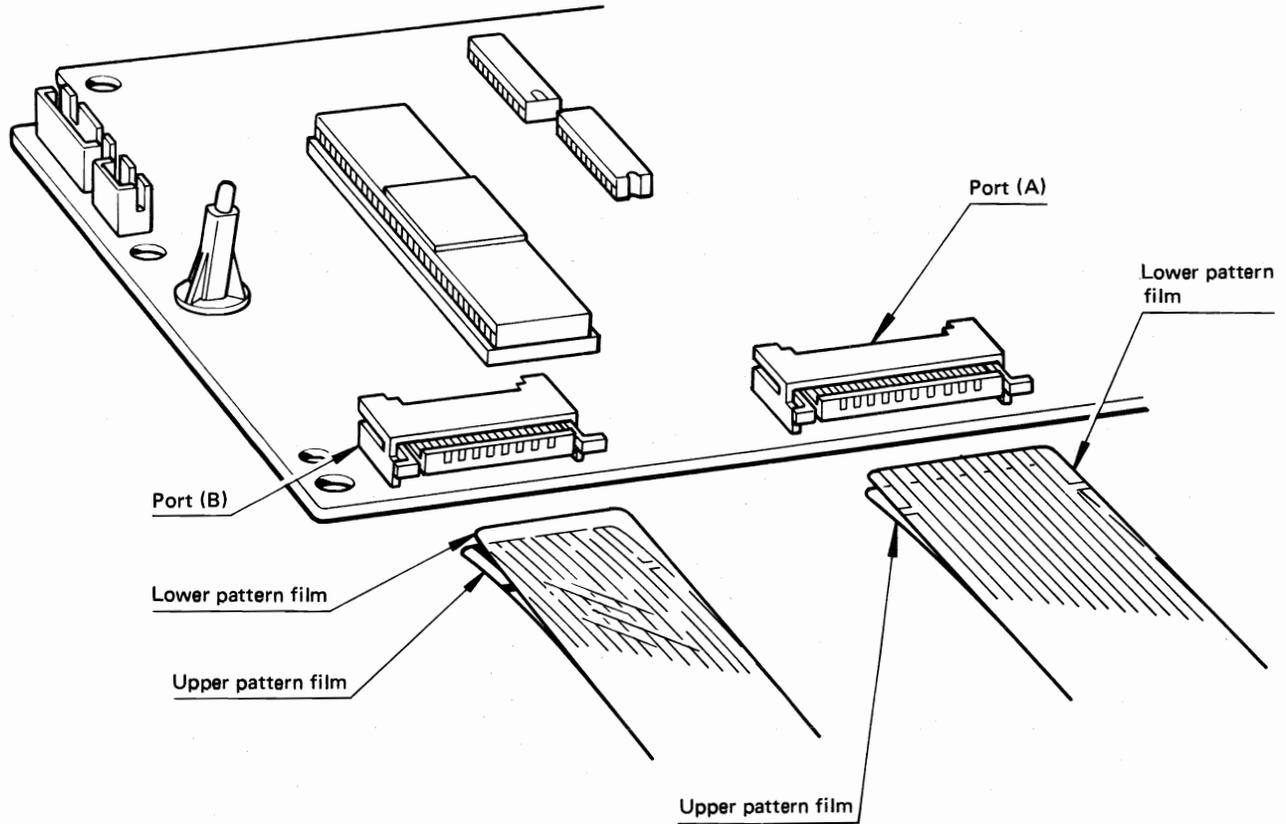
3.2.4 Reassembling the mechanical section

Align the two holes on the frame with the two bosses on the lower cover to reassemble the mechanical section. At the same time, make sure all lead wires are in their proper channels to prevent them from being pinched by the frame or covers.



3.2.5 Reconnecting the pattern films

Open the connector ports and into each, insert only the single layer of film on which the pattern is printed (lower pattern film into port (A) and upper pattern film into port (B)).



LUBRICATION

CHAPTER III. LUBRICATION

1. LUBRICATION SPECIFICATIONS

1.1 Lubricants

S.G. : Silicone grease KS64F

Grease B : Mobil Grease No. 1 and Liqui-Moly booster

The mixing ratio is 9 : 1.

E.G. : Epinoc grease #1

2. PRECAUTIONS

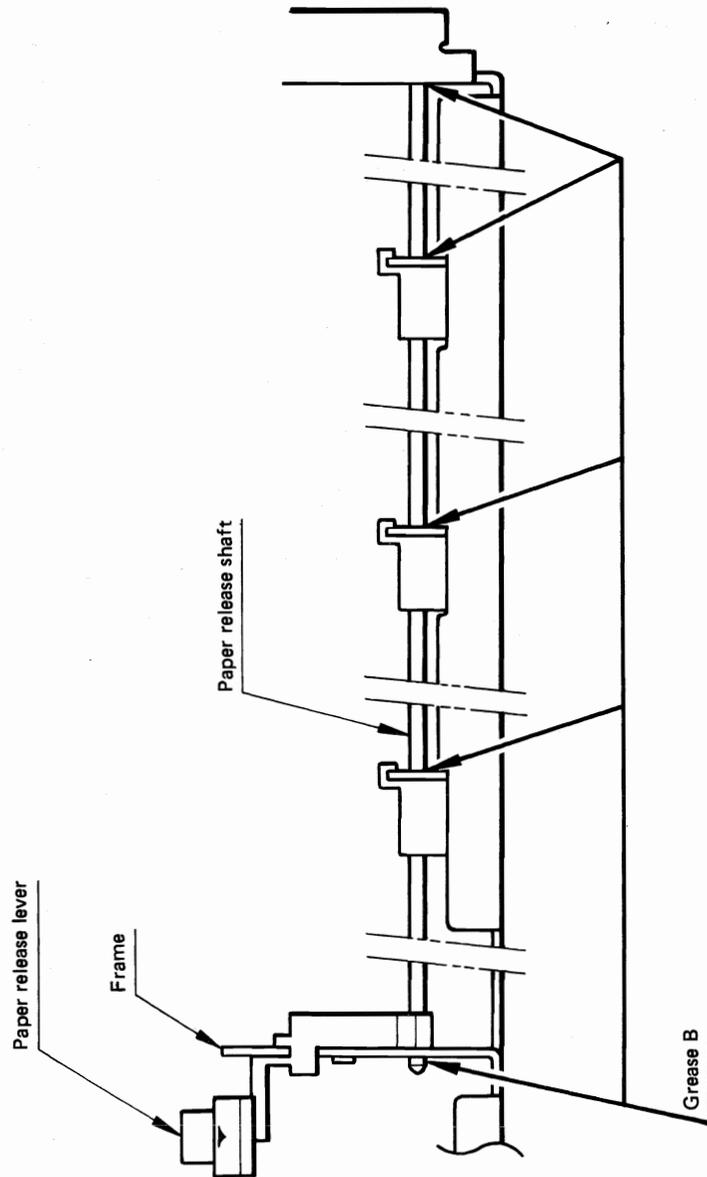
Use only the above specified lubricants. The warranty will not cover problems encountered due to the use of other lubricants, even though the warranty is still valid.

Since over-application of lubricants can cause damage to plastic parts, etc., apply only to the specified points and never more than necessary.

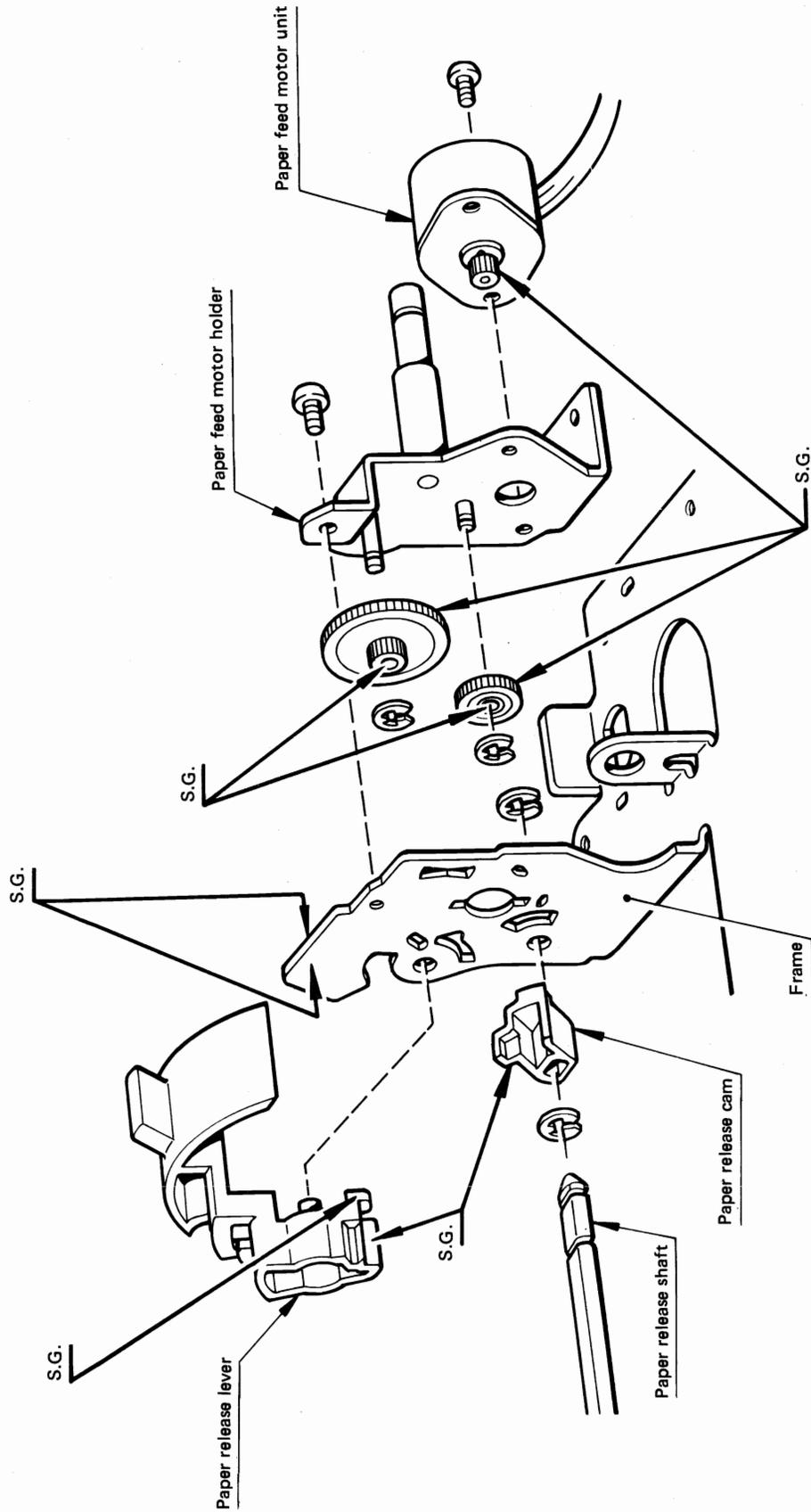
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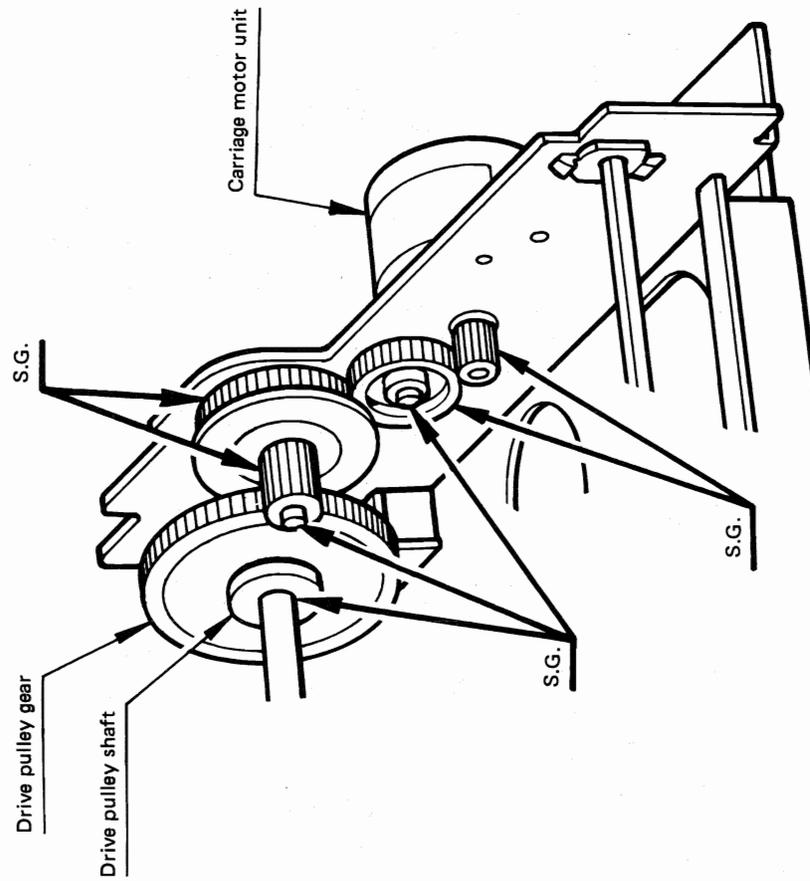
1. FRAME



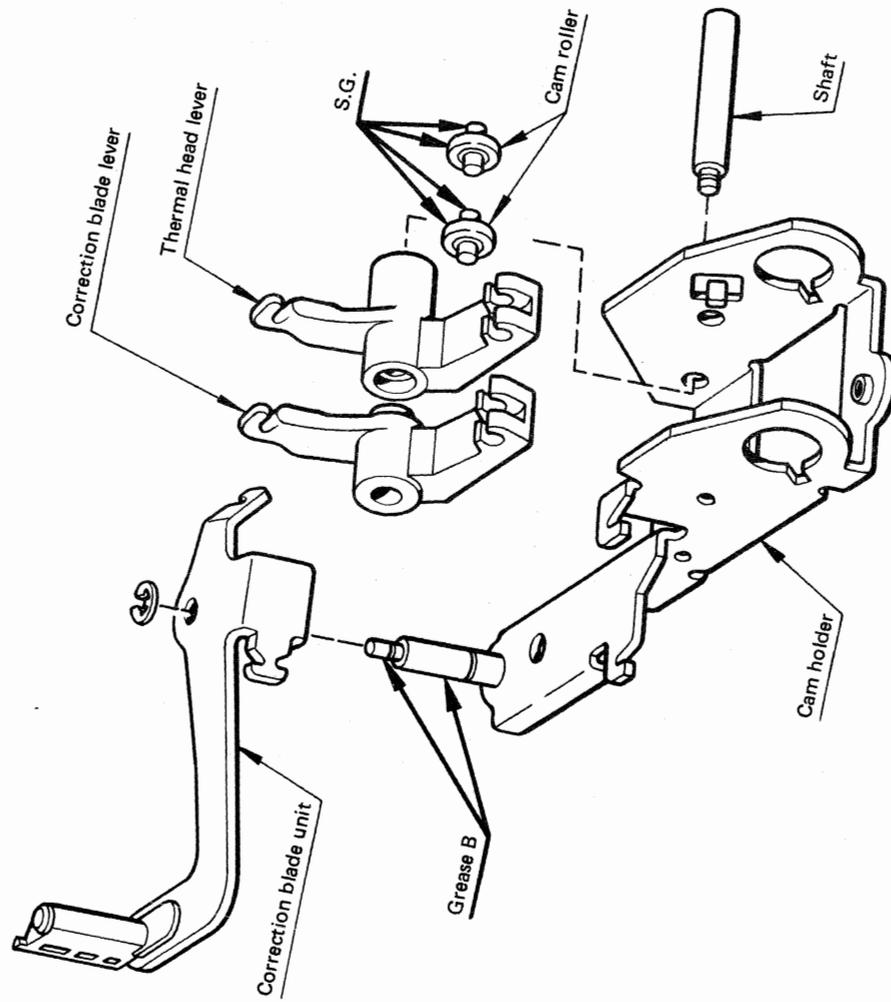
2. PAPER FEED MOTOR HOLDER

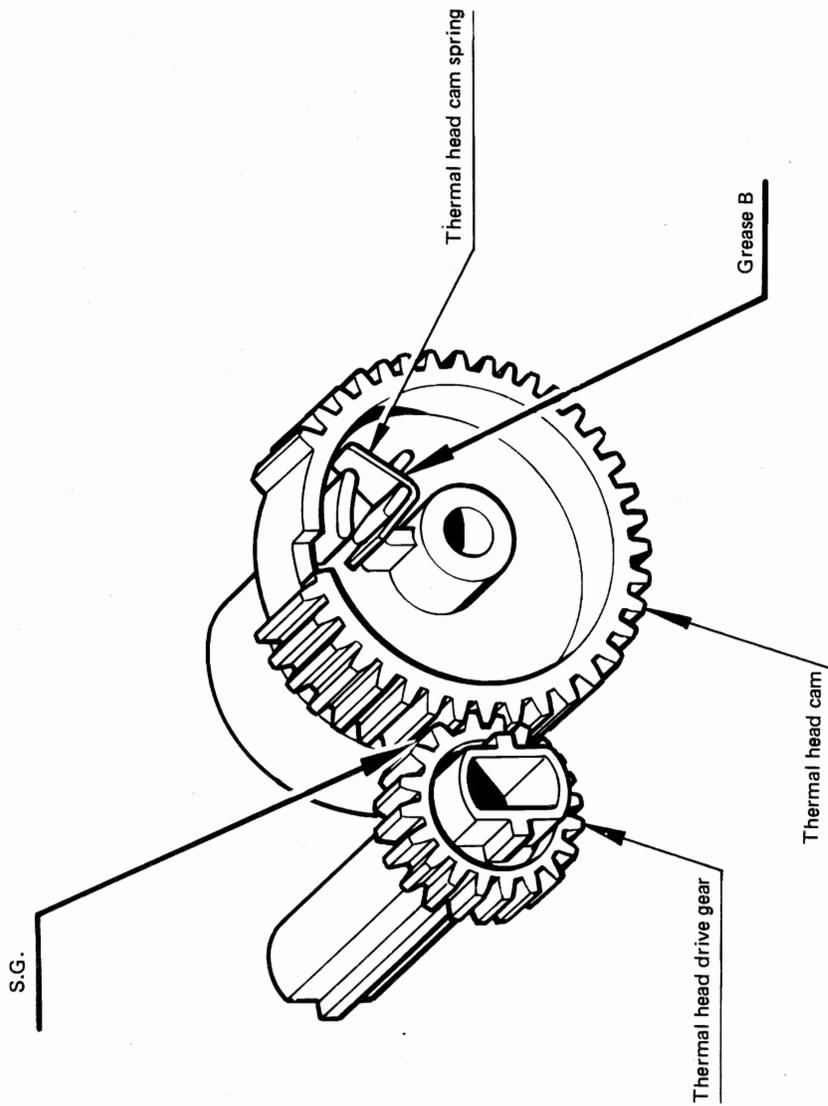


3. CARRIAGE MOTOR HOLDER

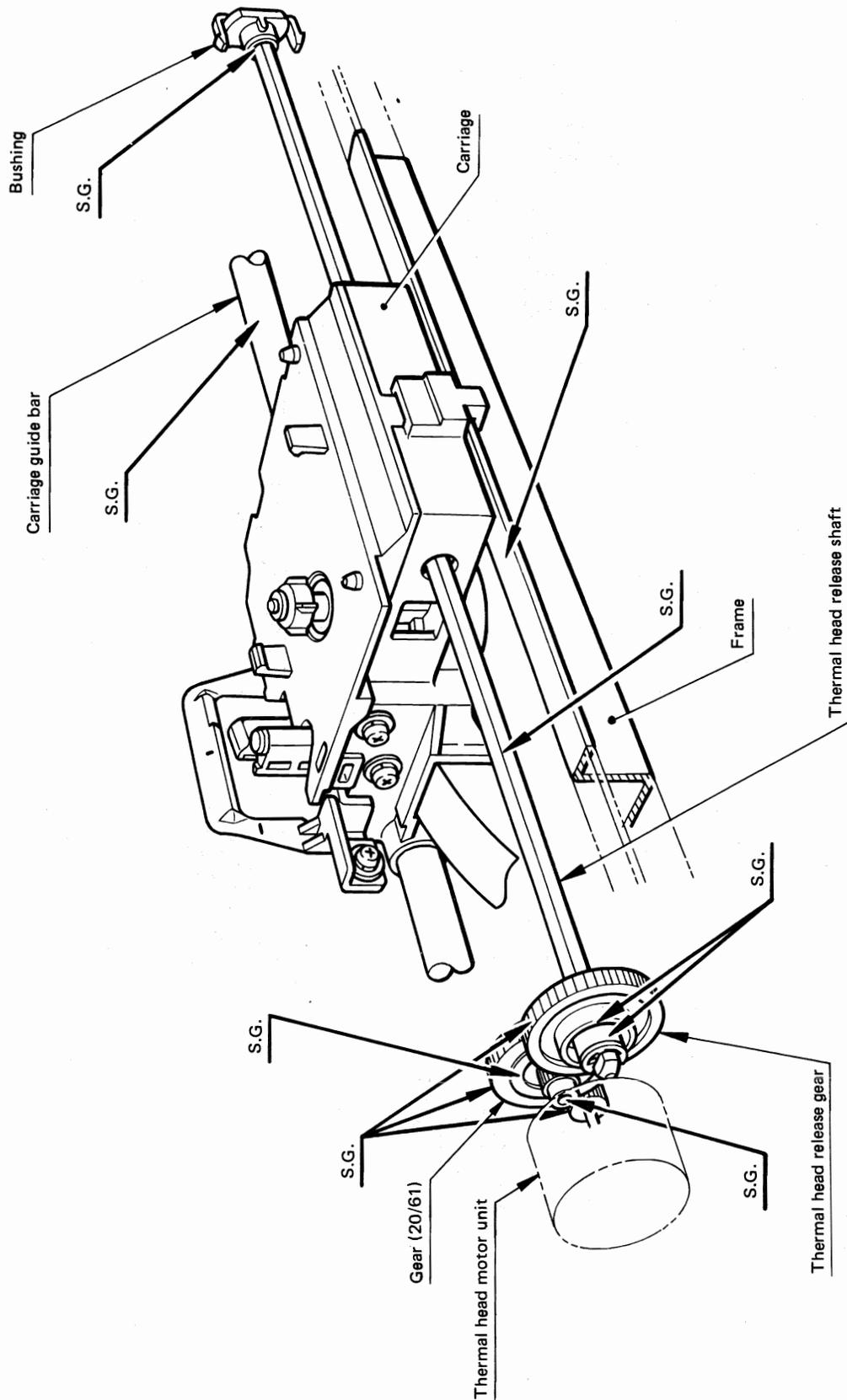


4. HEAD MECHANISM

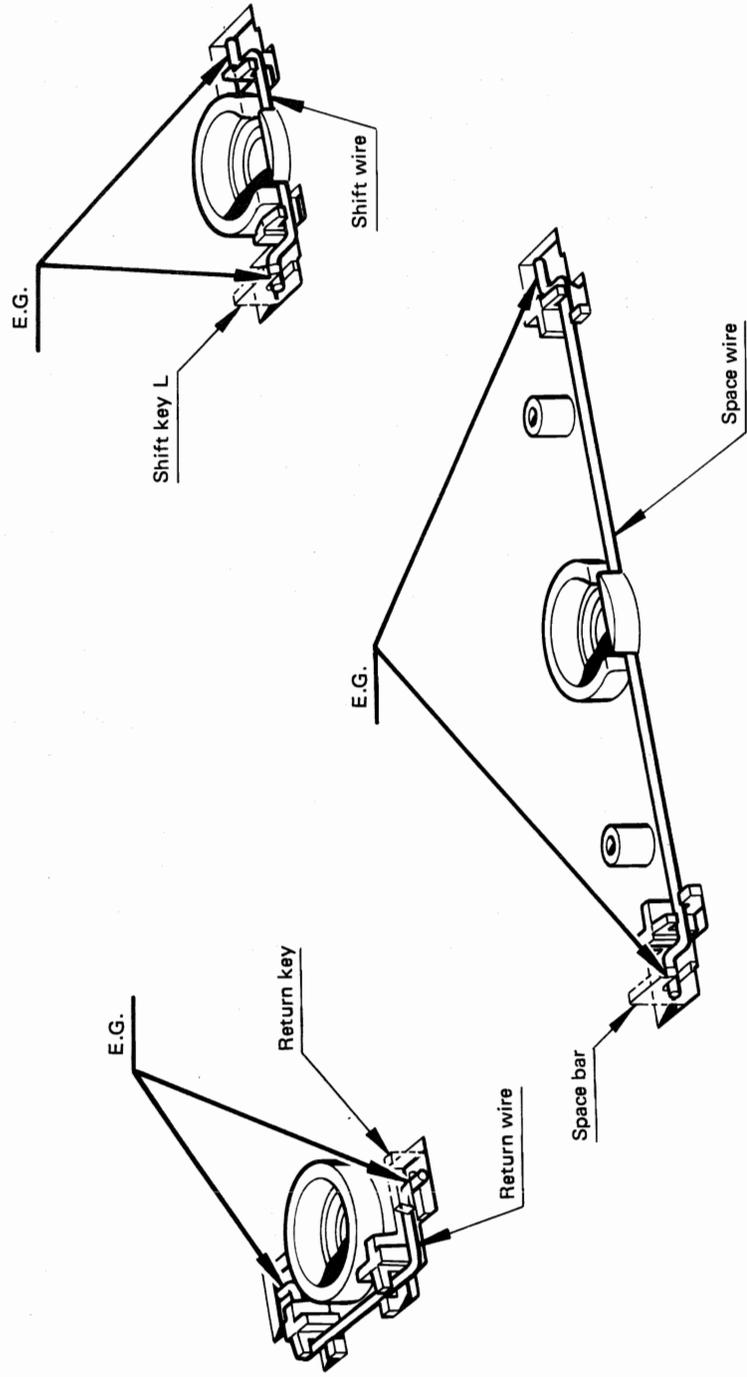




5. CARRIAGE MOVEMENT MECHANISM & CHASSIS ATTACHMENT



6. KEYBOARD



SERVICE MANUAL

(Electronic Part)

EP-5 & EP-150 TYPEWRITER SERVICE MANUAL
Electronic Part

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CHAPTER I. THEORY OF OPERATION

1. GENERAL

F1g. 1.1 shows the block diagram of the electronic part.
It is organized around the driver PCB.

1.1 Driver PCB (B517018)

1.1.1 Main CPU (HD6301YP)

This one-chip, 8-bit CMOS microcomputer incorporates a 16-Kbyte ROM and a 256 byte RAM and controls the entire EP-5 and EP-150 system. It registers key input and the font specifications the system has been set to. It also controls the thermal head drive, the three stepper motors, the piezo-electric buzzer, low voltage detection, and the two LED's.

1.1.2 Clock generator

The clock generator is incorporated into the main CPU but works in conjunction with an externally located ceramic oscillator (incorporating a 30 pF capacitor) to produce signals of 4 MHz \pm 1%.

1.1.3 Motor drive circuits

There are three motors in all: the carriage motor SM-25 (ϕ 25), the paper feed motor SM-20 (ϕ 20), and the thermal head motor SM-30 (ϕ 20). They are driven through their respective drive circuits by signals from the main CPU.

1.1.4 Thermal head drive circuit

Control signals from the main CPU pass through this circuit before energizing the thermal head.

This circuit incorporates two other circuits; a pro-TECTIVE circuit which prevents damage to the thermal head when the CPU is unable to function properly due to software runaway, and a temperature control circuit which changes the energizing time in accordance with the ambient temperature.

1.1.5 Buzzer drive circuit

The piezo-electric buzzer sounds when the buzzer drive circuit receives a clock signal of about 4.4 kHz sent from the clock generator in the main CPU.

1.1.6 LED drive circuit

When it detects that the power has been switched on, it sends a signal through the LED drive circuit to light up LED 1 (BATTERY LED).

When it detects that the battery is low, it sends a signal through the LED drive circuit which causes LED 1 to flash.

When the main CPU detects that the SHIFT function has been selected, it sends a signal through the LED drive circuit to light up LED 2 (the LED on the SHIFT LOCK key).

1.1.7 Voltage regulator circuit

This circuit produces two stabilized voltages of Vcc (+5V) and Vcon (+12V) from the fluctuating DC voltage supplied by the dry cell batteries or the AC adapter.

1.1.8 Low voltage detection circuit

This circuit monitors whether or not the battery voltage (V_{BT}) has fallen below 5.5 V. The V_{BT} voltage level is detected by using the threshold voltage level of the CMOS IC (TC4050BP).

1.1.9 Leaf switch detection circuit

This circuit monitors whether the leaf switch is on or off and sends this information to the main CPU.

1.1.10 Reset circuit

This circuit sends reset (\overline{RES}) signals to the main CPU when the power is switched on or off.

1.1.11 Font specification setting circuit

This circuit informs the main CPU which specifications the system is set to. The specification setting can be changed according to country by closing soldering points ① to ④.

1.1.12 Thermal head rank setting circuit

This circuit informs the main CPU of the thermal head rank. To set the rank, one of the points ① ~ ④ is soldered.

1.1.13 Key input detection circuit (membrane)

This circuit informs the main CPU which key is pressed. It takes the form of a matrix through which the key scanning signal is sent.

1.1.14 Indication circuit (slide switches)

This circuit informs the main CPU which option has been selected for each of the following functions:

typewriter or calculator mode (TW or CAL), line feed pitch (1, 1-1/2, or 2), automatic underline function (ON or OFF), style (NORMAL, BOLD, or EXPANDED), or density (LOW, MIDDLE, or HIGH).

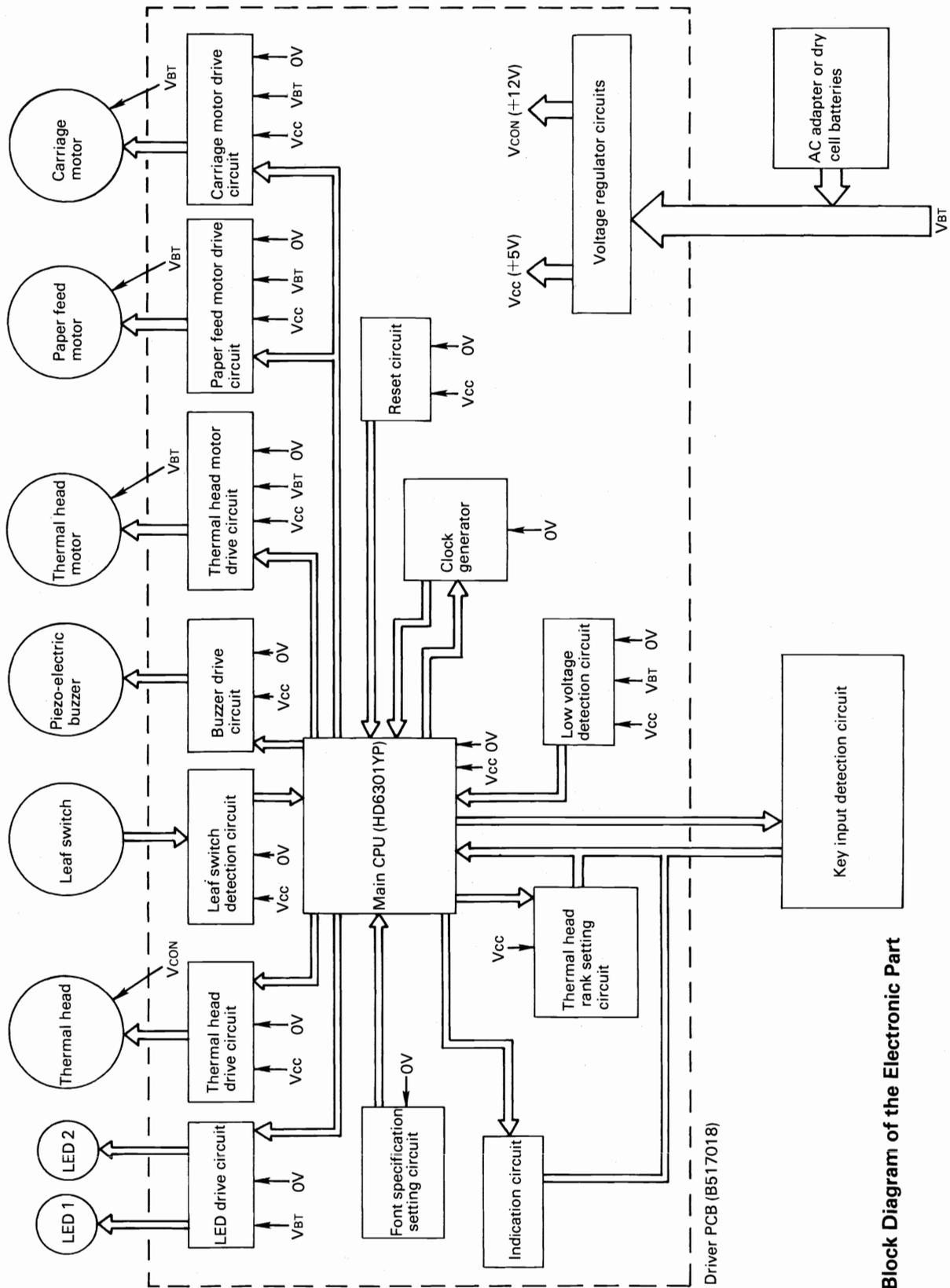


Fig. 1.1 Block Diagram of the Electronic Part

2. KEYBOARD

2.1 Construction of the Keyboard

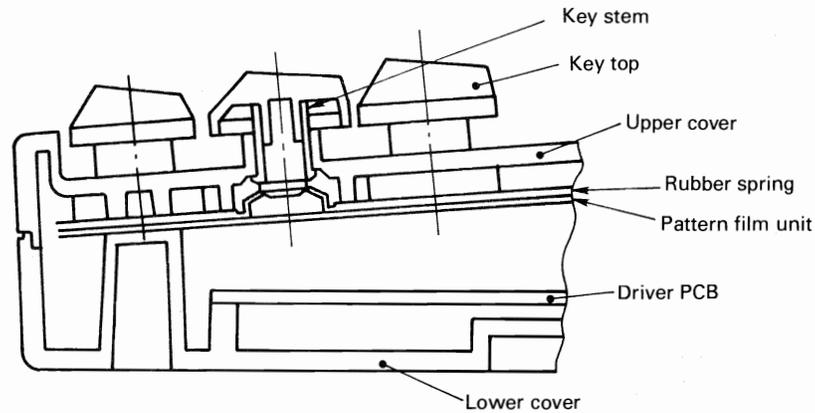


Fig. 2.1 Sectional View of the Keyboard

Fig. 2.1 shows a sectional view of the keyboard. The key top is fitted onto the key stem, whose movement is guided by the upper cover. Beneath the upper cover lie the rubber spring and pattern film unit.

2.2 Operation of the Keyboard

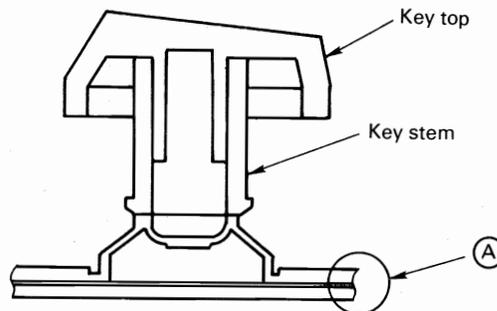


Fig. 2.2 Detailed Structure of the Keyboard

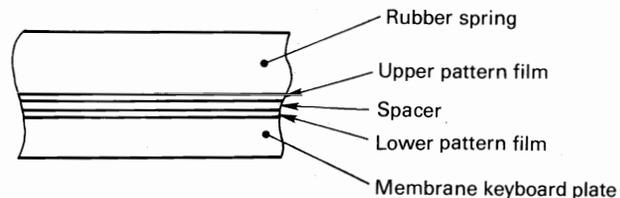


Fig. 2.3 Detail of Part A

The detailed construction of the keyboard is shown in Figs. 2.2 and 2.3. The rubber spring is composed of highly insulating silicone rubber. Beneath it lie the upper pattern film, the spacer, the lower pattern film, and the membrane keyboard plate.

There is a pair of electrodes, one each on the upper and lower pattern films; when the key is pressed, the electrodes contact each other through a hole in the spacer and close the circuit.

3. OUTLINE OF PROGRAM EXECUTION

Control of the EP-5 and EP-150 is by the 8-bit CPU HD6301YP. It controls the scanning of the keyboard and slide switches, paper feed motor drive, carriage motor drive, thermal head motor drive, thermal head drive, etc.

A time sharing method is adopted for the execution of control programs. Keyboard and slide switch scanning, processing of keyed-in data, etc., are dealt with in the main program, which is interrupted by subroutines such as that for control of the printing mechanism.

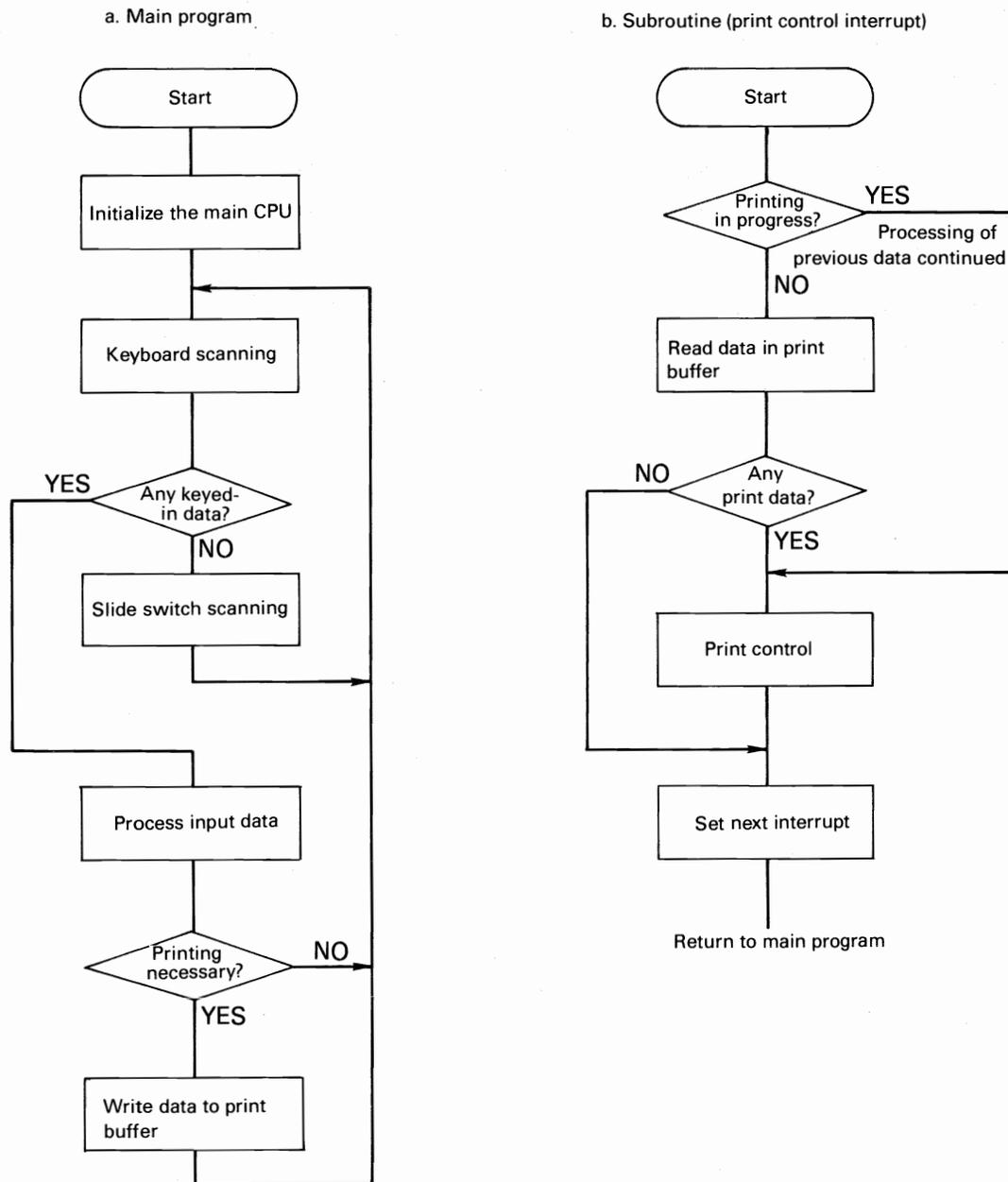


Fig. 3.1 Program Outline

As shown in Fig. 3.1, when there is no key data input, the main CPU normally scans the keyboard and is on standby waiting for data input. At this time, the control subroutine for operation of the printing mechanism interrupts the main program every 8 ms for execution of print control.

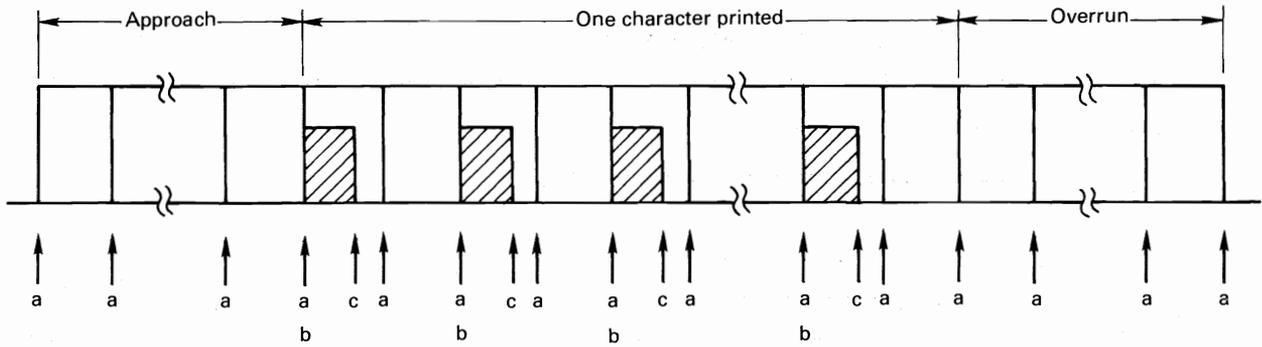
If there is no print data in the print buffer at the time of interruption, control is returned to the main program after preparation for the next interrupt (since there is no print data, this will come 8 ms later).

When data is input, the main CPU processes the data and writes it to the print buffer when printing is necessary. It then returns to the keyboard scanning program and goes on standby waiting for data input. The data written to the print buffer is read at the time of the next interrupt and the subroutine directs the printing mechanism to print in accordance with this data.

The subroutine controls the motor operation and thermal head drive during printing (i.e., interrupt). It sets the time required for this interrupt and directs printing only during the set time period. It then prepares for the next interrupt before returning control to the main program.

When the next interrupt comes, unfinished processing of data from the previous interrupt is executed until the printing operation is completed. The main CPU then checks for data in the print buffer again. (See Figs. 3.2 and 3.3).

Example of program execution during printing



* a, b, c and d indicate points where the subroutine interrupts or drive to mechanical parts goes on or off.

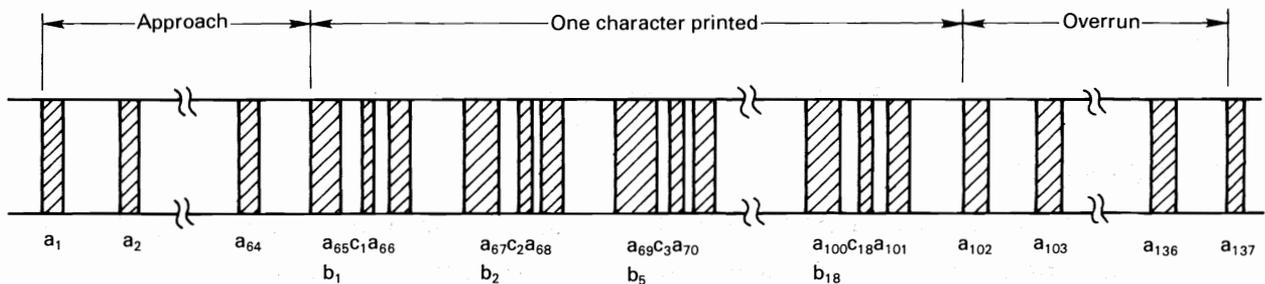
a...Carriage motor drive goes ON or motor phase changed

b...Thermal head drive ON

c...Thermal head drive OFF

d...Thermal head motor drive OFF

Fig. 3.2 Example of Print Subroutine Execution



The shaded bands represent the time taken for the execution of print control during subroutine interruptions. The unshaded bands indicate processing by the main program.

a₁ Carriage motor turned ON

a₂ ~ a₁₃₆ Carriage motor phase changed

a₁₃₇ Carriage motor turned OFF

b₁ ~ b₁₈ Thermal head turned ON

c₁ ~ c₁₈ Thermal head turned OFF

Fig. 3.3 Example of Program Execution Sequence

4. OPERATION AND PIN ASSIGNMENT OF THE MAIN CPU (HD6301YP)

4.1 Operation of the Main CPU (HD6301YP)

The main CPU (HD6301YP) is a CMOS microcomputer unit.

It incorporates a 16-Kbyte internal ROM, a 256-byte internal RAM, 48 input/output ports and 5 output-only ports.

Fig. 4.1 shows a block diagram of the main CPU.

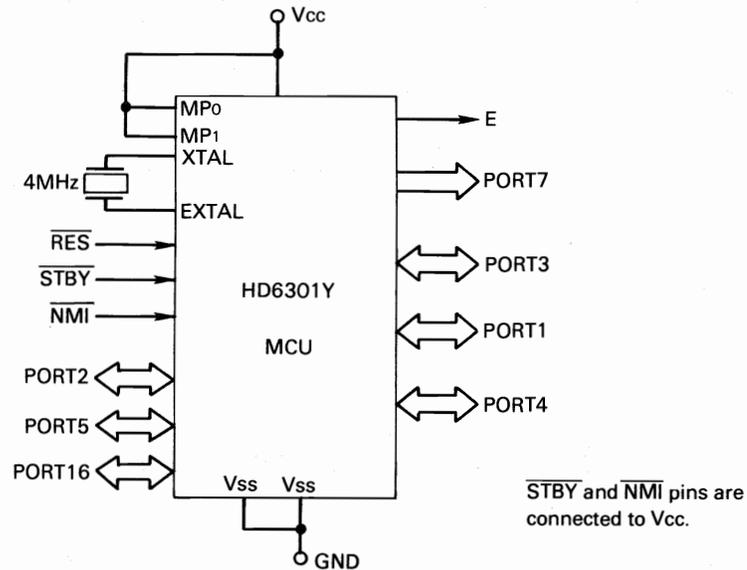


Fig. 4.1 Block Diagram of the Main CPU

4.2 $\overline{\text{RES}}$ Signal

The $\overline{\text{RES}}$ pin receives the $\overline{\text{RES}}$ signal which resets and initializes the main CPU. This pin must be held at the LOW signal level for at least 20 ms when the power is switched on.

Fig. 4.2 shows the reset circuit and Fig. 4.3 shows the signal reception timing at the $\overline{\text{RES}}$ pin.

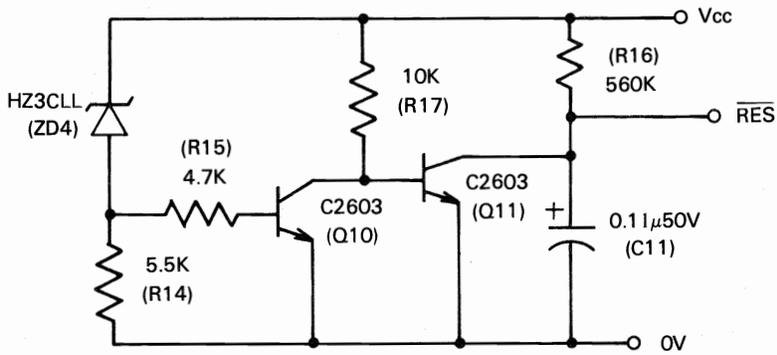
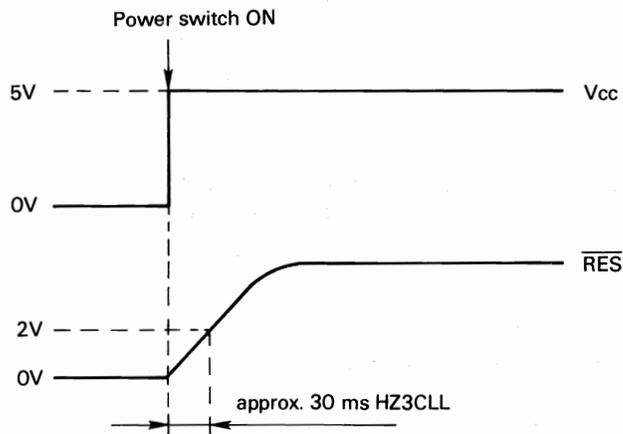


Fig. 4.2 Reset Circuit



In reality, the $\overline{\text{RES}}$ signal waveform looks like the pulse waveform in Fig. 4.3 due to the threshold element of the main CPU.

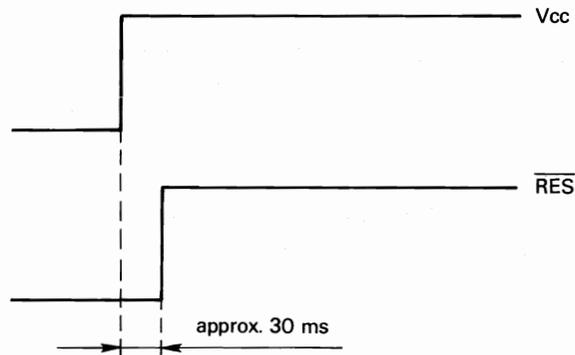


Fig. 4.3 Signal Reception Timing

4.3 Main CPU Pin Assignment (HD6301YP)

Pin No.	Input/ Output	Function	Meaning		Initial Setting
			0	1	
1		Vss: 0V			
2 3	Input	XTAL EXTAL A deramic oscillator is connected to these two pins. Its frequency is 4 MHz, but this is reduced to clock generator 1 MHz by an incorporated frequency divider circuit.			
4 5		MP ₀ (MP = mode program) MP ₁ These pins determine the mode of the main CPU. In this system, the mode is set to "3" (the single chip mode), i.e., both MP ₀ and MP ₁ are always HIGH.			
6		$\overline{\text{RES}}$ (Reset) This pin receives the signal which resets and initializes the main CPU when the power is switched on.			
7		$\overline{\text{STBY}}$ (Standby) Not used. This signal level at this pin is always HIGH.			
8		$\overline{\text{NMI}}$ (Non-maskable interrupt) Not used. The signal level at this pin is always HIGH.			
9 (P29)	Output	PC (Power cut) Signals output from this port cut the power off to the themal head.	Thermal head drive power OFF.	Thermal head drive power ON.	0
10 (P21)		ENA (Enable) Signals output from this pin enable the thermal head drive.	Thermal head turned OFF.	Thermal head turned ON.	0
11 (P22)		CLK (Clock) Clock signals controlling the timing of the thermal head drive are output from this pin.			0
12 (P22)		Not connected.			

Pin No.	Input/ Output	Function	Meaning		Initial Setting
			0	1	
13 (P24)	Output	DATA Thermal head drive serial data signals are output from this pin.	Dot OFF	Dot ON	1
14 (P25)		LAT (Latch) Thermal head drive latch signals are output from this pin.		See below (*)	0
15 (P26)		BUZ Buzzer drive signals are output from this pin.	Oscillation		0
16 (P27)		LED 1 (BATTERY LED) drive signals are output from this pin.		Lit	0
17 (P50) { 24 (P57) 25 (P60)		Keyboard scanning signals Keyboard scanning signals are output from these pins.	Keyboard scanning in progress		1
26 (P61)		CRS Carriage motor selection signals are output from this pin when P30-33 are to be used for carriage motor drive signals.	Carriage motor not selected	Carriage motor selected	0
27 (P62)		LFS Paper feed motor selection signals are output from this pin when P30-33 are to be used for paper feed motor drive signals.	Paper feed motor not selected.	Paper feed motor selected.	0
28 (P63)		Input	OPOS Carriage home position detection signals from the leaf switch are input to this pin.		
29 (P64)	WB Weak battery (low voltage) detection signals are input to this pin.		Weak battery		
30 (P65)	Output	LED 2 SHIFT LED drive signals are output from this pin.		LED lit	0
31 (P66)		Not connected			
32 (P67)		THR Thermal head rank scanning signals are output from this pin.	Rank being scanned		1

* Data latched at the rising edge of the latch signal.

Pin No.	Input/ Output	Function	Meaning		Initial Setting	
			0	1		
33		Vcc: +5V				
34 (P47) } 41 (P40)	Input	Key input detection signals are input to these pins.	Key input being received			
42		Vss: 0V				
43 (P17) } 46 (P14)	Output	Signals (4-bit binary) informing the main CPU of the current font specification setting are input to these pins.	"0"	"1"		
47 (P13) } 50 (P10)		Not used (connected to the 0V pin.)				
51 (P37) } 54 (P34)	Output	Phase excitation signals for phases 4 to 1 are output from these pins to the thermal head motor.		Phase excitation of motor	0	
55 (P33) } 58 (P30)		Phase excitation signals for phases 4 to 1 are output from these pins to either the carriage motor or the paper feed motor.		Phase excitation of motor		
59 (P74)		SW5 LINE switch (paper feed pitch) scanning signals are output from this pin.	Scanning in progress			1
60 (P73)		SW4 STYLE switch (print style) scanning signals are output from this pin.				
61 (P72)		SW3 DENSITY switch (print density) scanning signals are output from this pin.				
62 (P71)	SW2 UNDL switch (underline) scanning signals are output from this pin.					
63 (P70)	SW1 MODE switch (TW/CAL selection switch) scanning signals are output from this pin.					
64		Not connected				

5. OPERATION OF THE MAIN CPU AND PERIPHERAL CIRCUITS

5.1 Key Input Detection Circuit and Indication Circuit

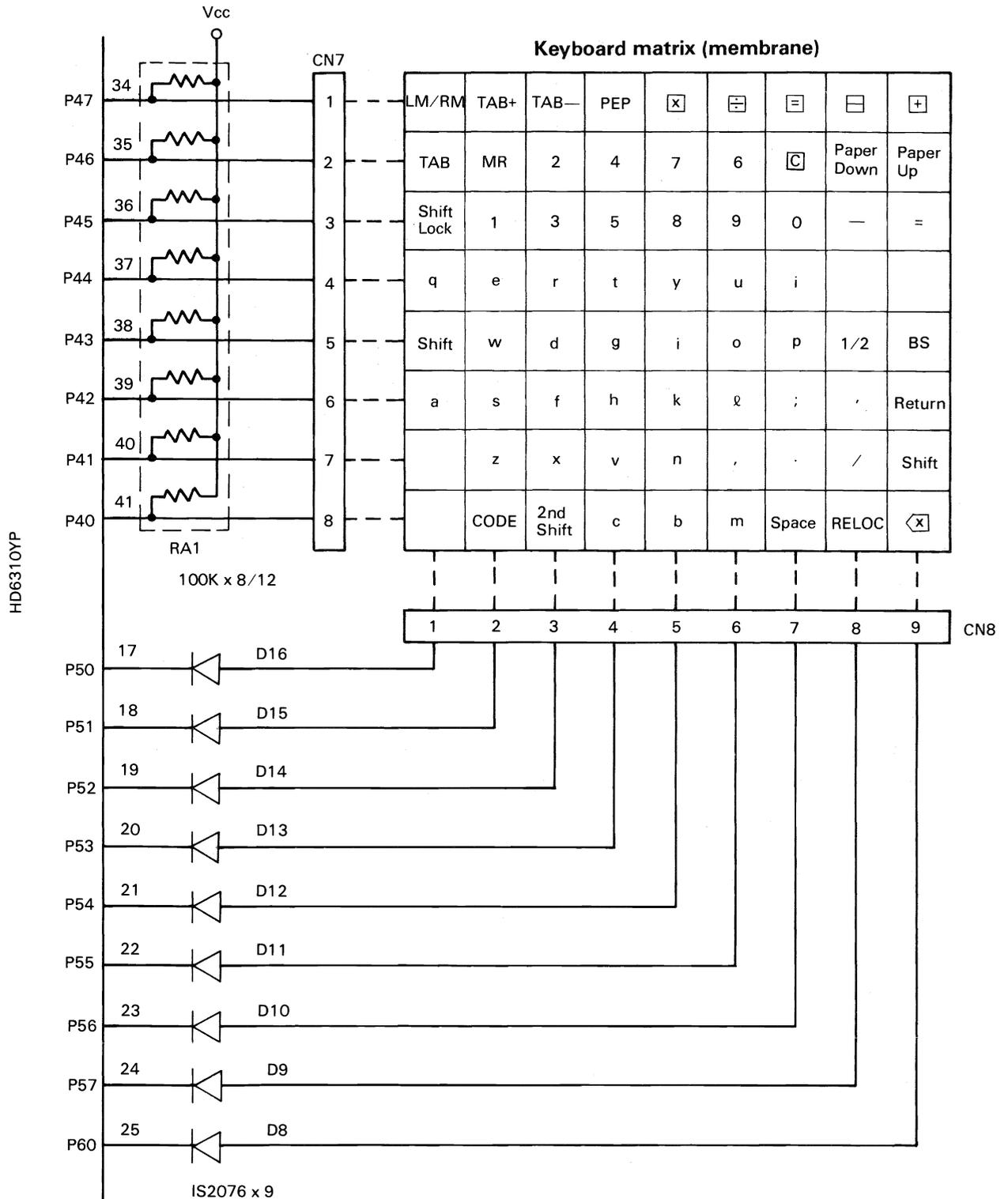


Fig. 5.1 Key Input Detection Circuit

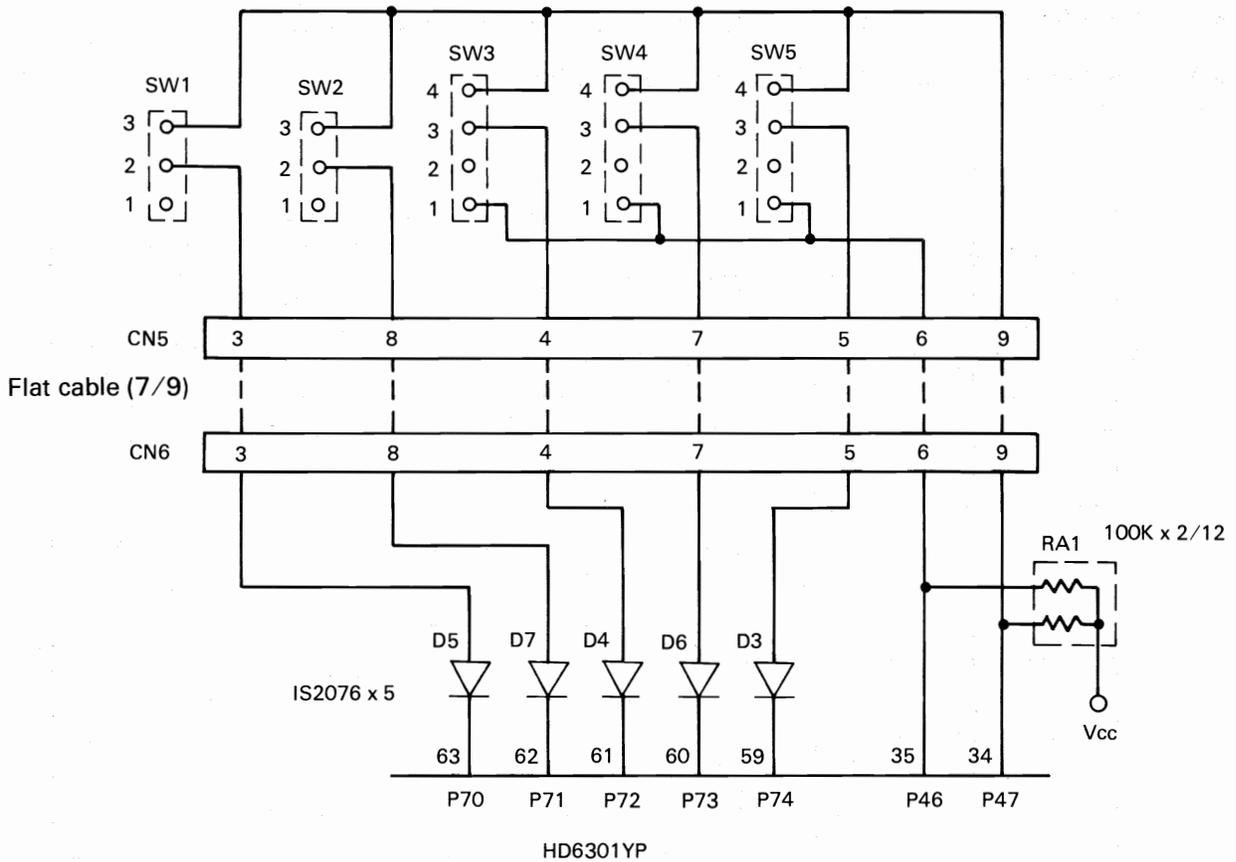


Fig. 5.2 Display Circuit

Fig. 5.1 shows the key input detection circuit. The main CPU monitors which keys are being pressed by outputting keyboard scanning signals like those shown in Fig 5.3 to this circuit. For example, if the LM/RM key is pressed, a LOW signal is input to P47 (pin 34) when the keyboard scanning signal from P50 (pin 17) is output. This LOW signal tells the main CPU that the LM/RM key is being pressed.

The indication circuit is shown in Fig. 5.2. The main CPU monitors the current setting of the slide switches by outputting scanning signals like those shown in Fig. 5.3 to this circuit.

The slide switches illustrated in Fig. 5.2 have the following functions.

- SW1: Switches between typewriter and calculator modes (TWR/CAL).
- SW2: Switches the automatic underlining function on or off (UNDL ON/OFF).
- SW3: Sets the print density to low, medium or high (L/M/H).
- SW4: Sets the print style (BOLD/EXP/OFF).
- SW5: Sets the paper feed pitch (1, 1-1/2, 2).

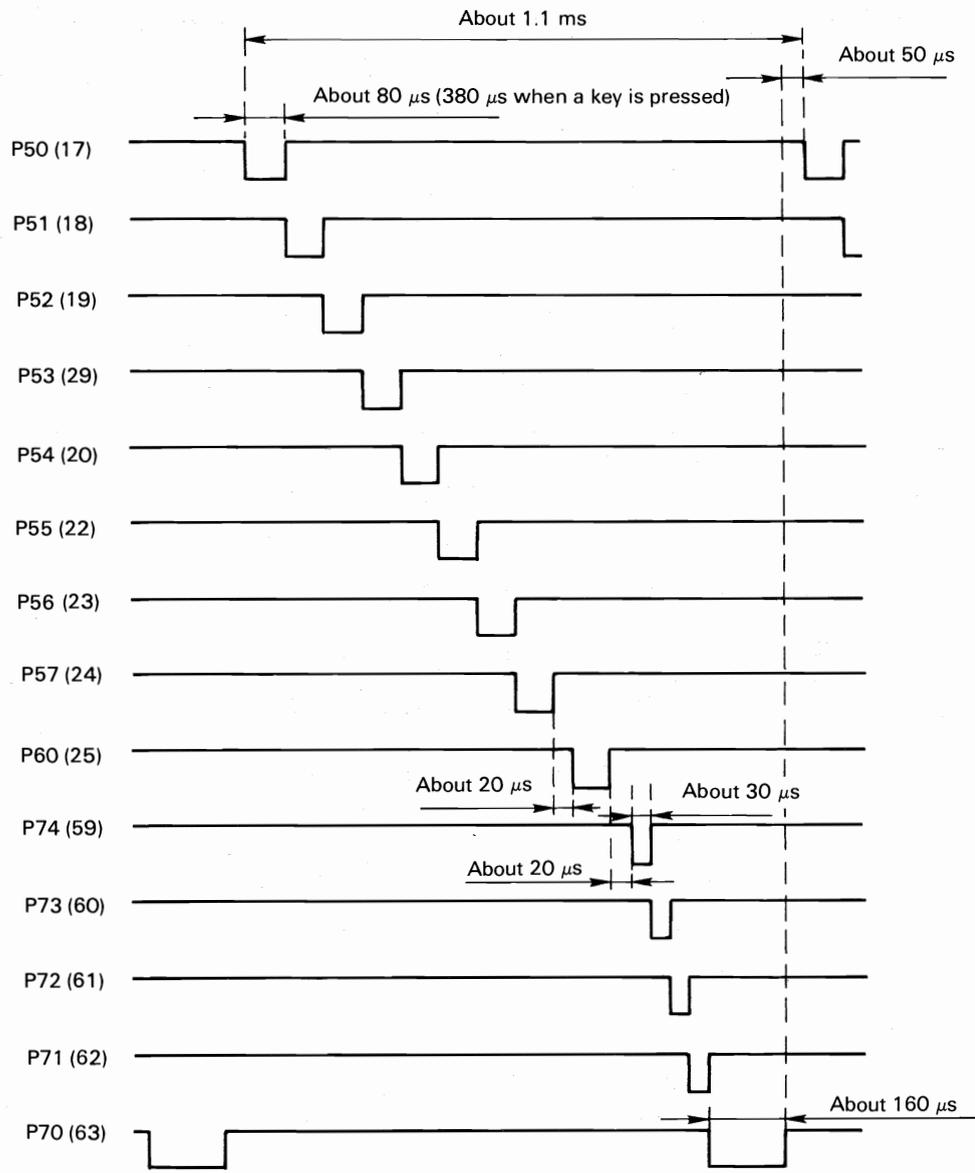


Fig. 5.3 Scanning Signals

5.2 Font Specification Setting Circuit and Thermal Head Rank Setting Circuit

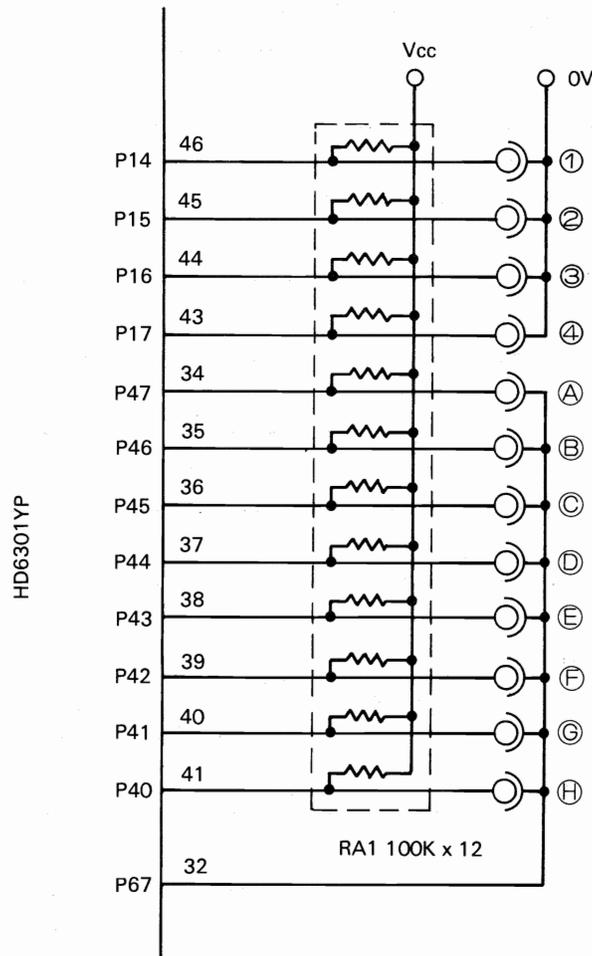


Fig. 5.4 Font Specification Setting Circuit and Thermal Head Rank Setting Circuit

Solder points ① to ④ shown in Fig. 5.4 are associated with the font specification setting circuit while ①A to ①H are associated with the thermal head rank setting circuit. Font specifications and thermal head rank are set by closing the appropriate solder point(s).

The thermal head rank is read once only (immediately after the power is switched on) by a scanning signal output from P67 (pin 32) on the main CPU. If none of the thermal head rank solder points have been closed, or two or more have been closed, the typewriter will not operate.

Solder point settings for font specifications are shown in Table 5.1 and those for thermal head rank are shown in table 5.2.

	④	③	②	①
French	L	L	L	
German	L	L		L
British English	L	L		
Dutch	L		L	L
Norwegian	L		L	
American English	L			L
Danish	L			
Spanish for Spain		L	L	L
Spanish for S. & C. America		L	L	
Bilingual		L		L
Portuguese		L		
Swiss French			L	L
Finnish			L	
Swiss German				L
Swedish				
Italian	L	L	L	L

L: Solder point closed
Blank: Solder point open

Table 5.1 Solder Point Settings for Font Specifications

(ohms) Resistance \ E (μm)	150 ~ 125	125 ~ 100	100 ~ 80
240 ~ 225	A	B	C
225 ~ 212	B	C	D
212 ~ 200	C	D	E
200 ~ 190	D	E	F
190 ~ 180	E	F	G

Table 5.2 Solder Point Settings for Thermal Head Rank

* E is the distance from the edge of the ceramic plate in the thermal head to the closest edge of the thermal elements.

5.3 LED Drive Circuit

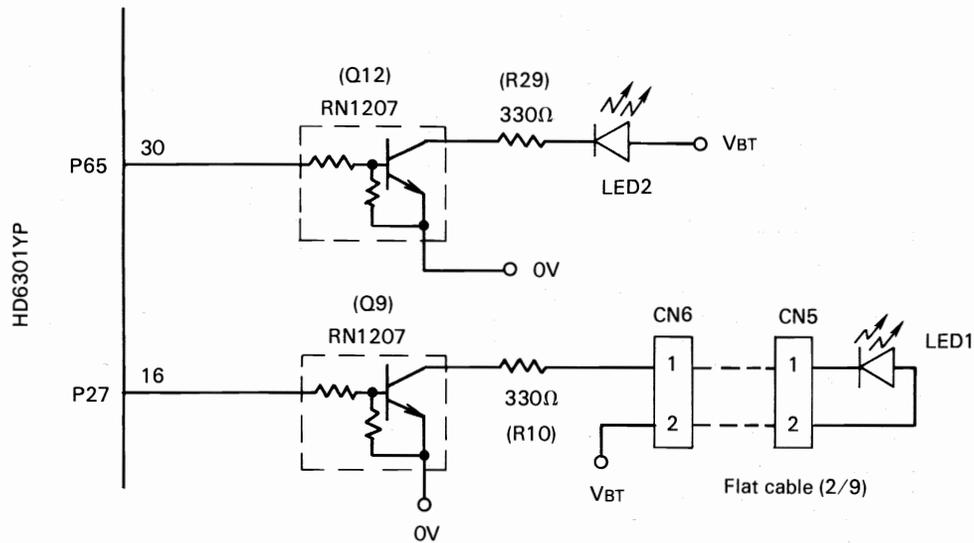


Fig. 5.5 LED Drive Circuit

Fig. 5.5 shows the LED drive circuit.

While the power is on, P27 (pin 16) on the main CPU goes HIGH, causing LED 1 to light up. When the main CPU detects low voltage, it outputs a pulse train from P27 which causes LED 1 to flash, informing the user that the batteries are weak.

When the SHIFT key is held down, or the SHIFT LOCK key pressed, P65 (pin 30) on the main CPU goes HIGH, causing LED 2 to light up.

Transistors Q9 (RN1207) and Q12 (RN1207) are LED1 and LED2 drivers.

5.4 Thermal Head Drive Circuit

Fig. 5.6 shows the thermal head drive circuit. It is composed of three circuits; the driver IC (M5497OP), the temperature control circuit which reacts to the ambient temperature, and the protective circuit which protects the thermal head if the main CPU becomes unable to operate properly due to software runaway.

Data is serially transferred from P24 (DATA) of the main CPU to the driver IC in synchronization with the clock signals output from P22 (CLK) of the main CPU.

The serial data is converted to parallel data by the latch signal from P25(LAT). EN signal determines the timing of the output of the parallel data from the driver IC to the thermal head, which it energizes.

Two sets of serial data are output for the thermal head to print one line. The first set is "record data" which indicates those thermal elements which were energized last and therefore retain some residual heat. The second is the "main data" which indicates which thermal elements are to be energized.

The temperature control circuit uses a thermistor to adjust control of the printing and correction mechanisms in accordance with the ambient temperature so as to avoid any temperature-related variations in the performance of these mechanisms.

It adjusts the pulse width of the signal received from P21 (ENA) to produce the EN signal. The new pulse width is determined by the thermistor and the time constant of the resistor and capacitor in the circuit.

If there is a software runaway, and the signal from P21 (ENA) fails to go LOW, parallel data output to the thermal head is forcibly stopped after a constant time interval fixed by the time constant of the resistor and capacitor, thus protecting the thermal head.

The power cut signal output from P20 (PC) controls the power supply circuit in the driver IC. When the thermal head drive circuit is idle, it goes LOW to reduce the consumption of current in the driver IC.

The EN signal sometimes exceeds the rated thermal head wattage due to printing or temperature conditions.

When this happens, the PC signal forces it to go LOW.

Fig. 5.7 shows a time chart for the thermal head drive.

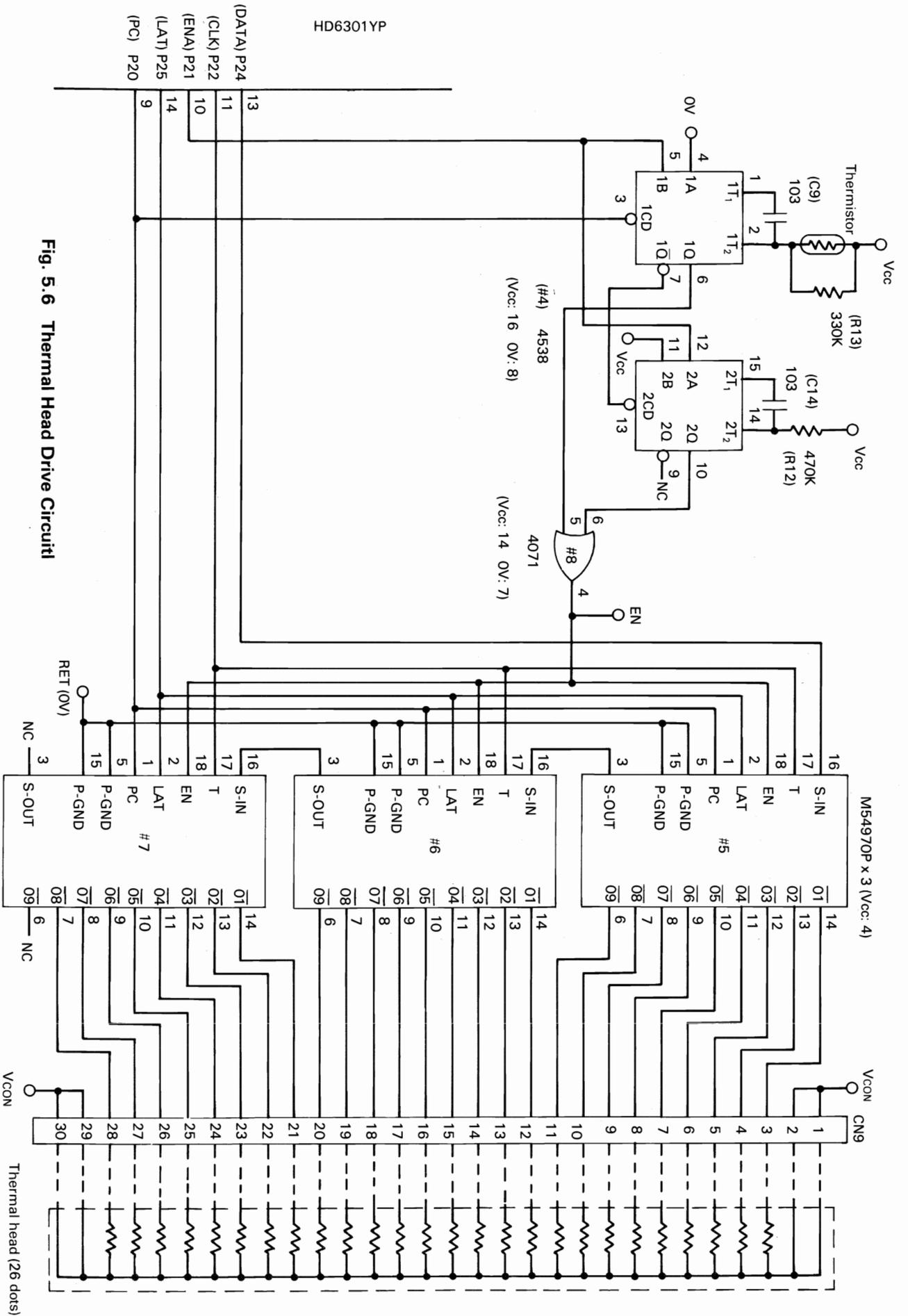


Fig. 5.6 Thermal Head Drive Circuit

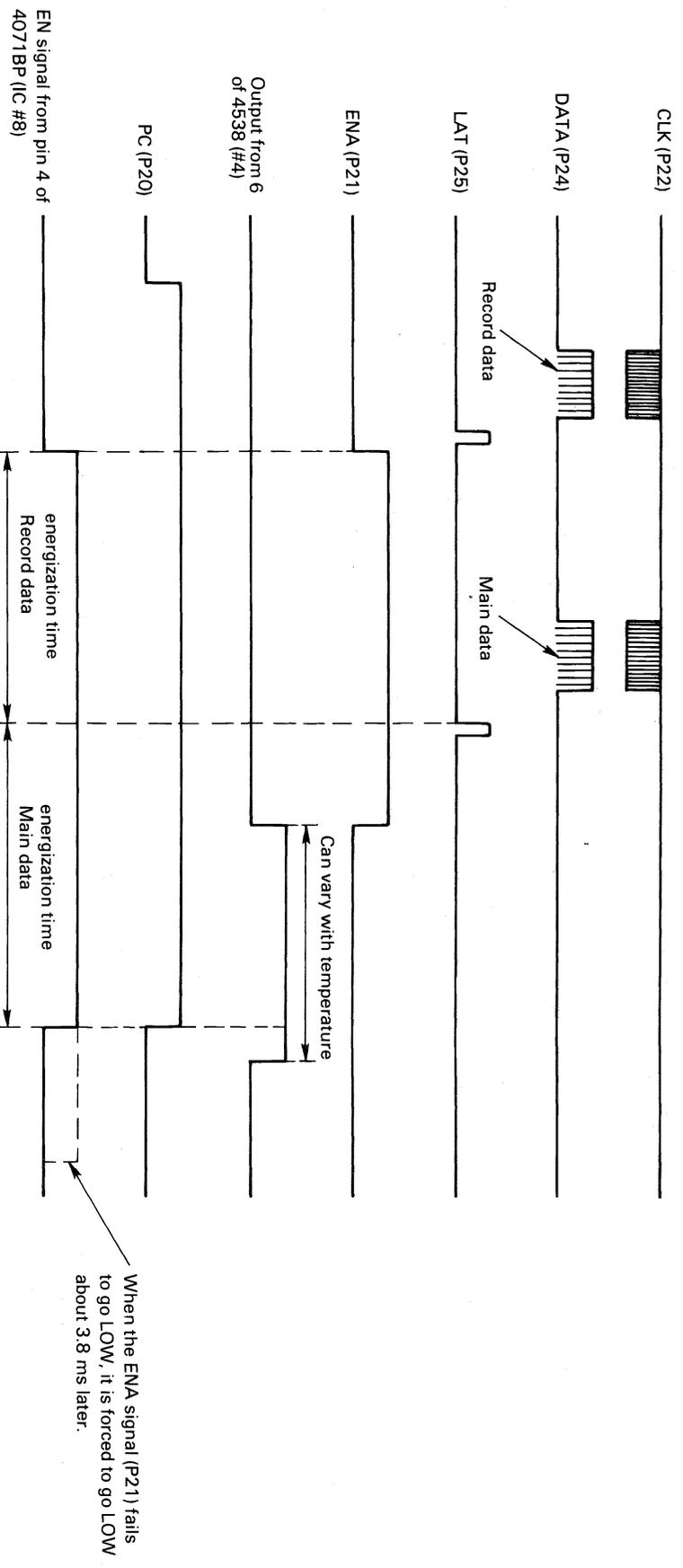


Fig. 5.7 Thermal Head Drive Timing Chart

5.5 Motor Drive Circuits

The main CPU outputs carriage motor and paper feed motor control signals from P30 ~ P33 and thermal head motor control signals from P34 ~ P37 in accordance with the input data it processes. These signals pass through the motor drive circuit (M54539P) which converts them to the drive signals to drive the motors.

P61 (carriage motor selection port) goes HIGH when the carriage motor is to be driven, and P62 (paper feed motor selection port) goes HIGH when the paper feed motor is to be driven. They cannot both be HIGH at the same time. All motors are driven in one-two phase excitation (see Fig. 5.8). The drive cycles for the motors are detailed below.

5.5.1 Carriage motor

(1) Printing

Four speed-up pulses (to gradually bring the motor up to operating speed) and four slow-down pulses (to gradually bring the motor to a stop).

2.14 ms/pulse (468 pps during operation)

(2) Correction

Four speed-up pulses and four slow-down pulses.

2.53 ms/pulse (396 pps)

(3) Medium speed drive (space repeat and back space repeat)

18 speed-up pulses and 18 slow-down pulses.

1.25 ms/pulse (800 pps)

(4) High speed drive (tabulation and carriage return)

36 speed-up pulses and 36 slow-down pulses.

1 ms/pulse (1000 pps)

5.5.2 Paper Feed Motor

30 speed-up pulses.

1.92 ms/pulse (520 pps)

5.5.3 Thermal Head Motor

Three speed-up pulses and three slow-down pulses.

1.67 ms/pulse (600 pps)

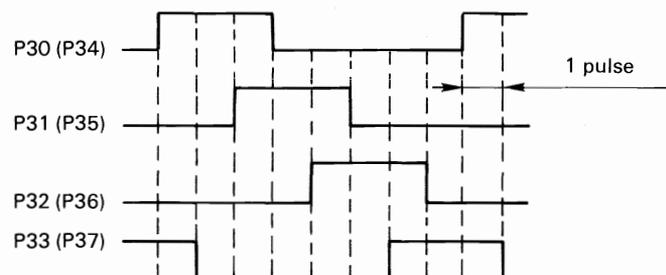


Fig. 5.8 Motor Drive Signal Wave Forms

#2, #3 4081 (Vcc: 14, 0V: 7)
 #10 4050 (Vcc: 1, 0V: 8)
 #1, #9 M54539 (RET: 8)

HD6301YF

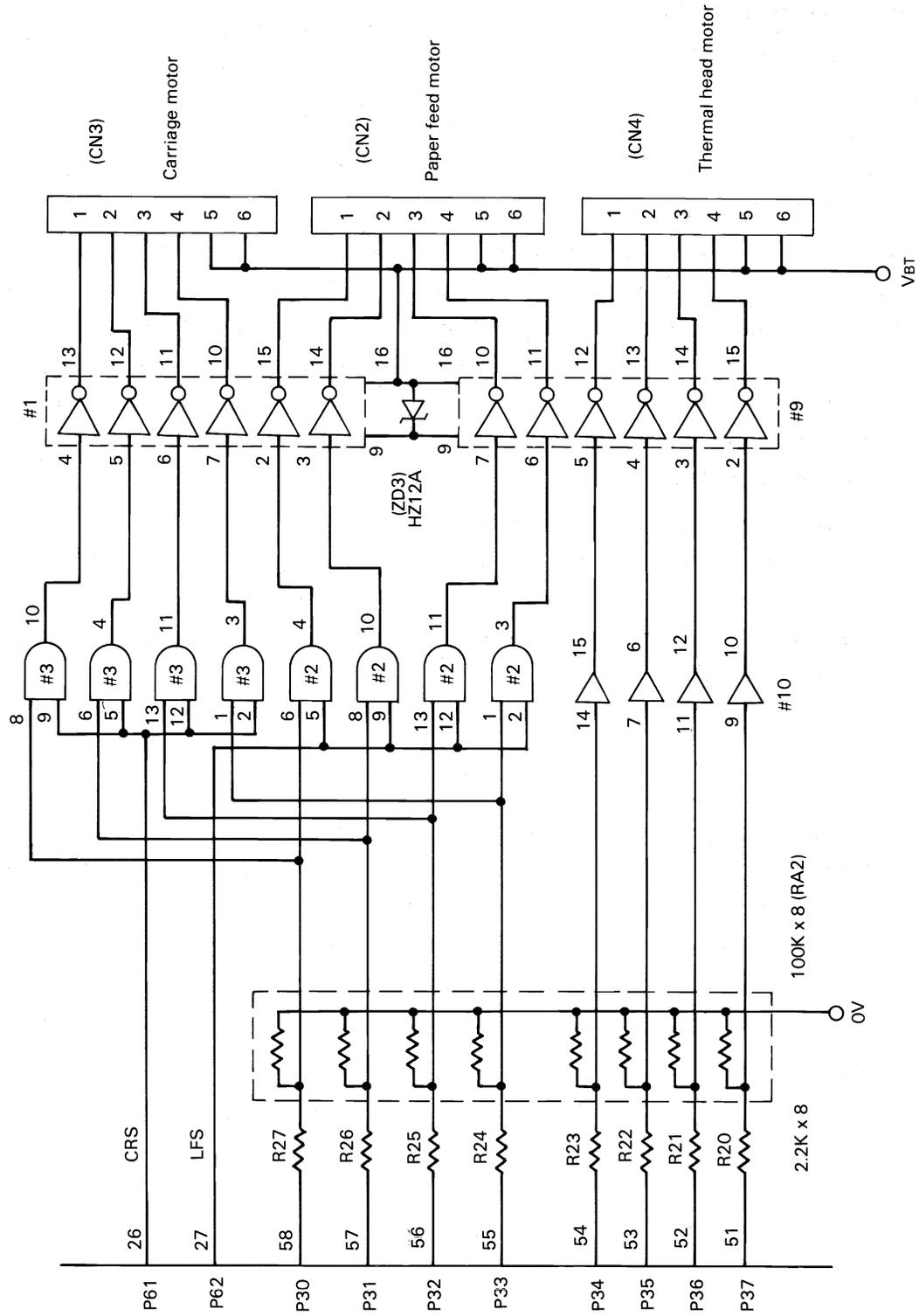


Fig. 5.9 Motor Drive Circuits

5.6 Voltage Regulator Circuits

Fig. 5.11 shows the voltage regulator circuits.

5.6.1 V_{CC} supply voltage regulator circuit

This circuit keeps V_{CC} supply voltage within $+5 \pm 0.3$ V despite V_{BT} (battery) input voltage fluctuations.

In normal operation, the coil across pins 1 and 2 of transformer T1 of transistor Q2 and the coil across pins 3 and 4 of transistor Q3 generate an oscillating voltage which is output from pin 6, rectified by the diode D1 and smoothed by the capacitor C6 to produce the V_{CC} supply. It goes through Zener diode ZD1, and the current output from ZD1 is then controlled as the base current by transistor Q1. In effect, the voltage is regulated by altering the oscillation frequency produced by Q2 and Q3.

5.6.2 V_{CON} supply voltage regulator circuit

V_{CON} is the 12-V supply to the thermal head. An oscillating voltage is generated by transistors Q6 and Q7, coil L1, a capacitor, and a resistor.

Transistor Q5 regulates the voltage by reference to the current level output from Zener diode ZD2.

Transistor Q4 controls oscillation. D2 is a rectifying diode, and C4 is a smoothing capacitor.

5.6.3 Power switch peripheral circuits

Power may be supplied by five size-D dry cell batteries or by an AC adapter. When the AC adapter is plugged in, the \oplus (positive contact for batteries) and \oplus ' (positive contact for AC adapter) in the power jack open and the positive contact of the AC adapter connects with the positive contact inside the power jack, thus disconnecting the battery circuit.

Whichever power source is used, power is supplied to V_{BT} when the power switch is set to the ON position.

When the power is switched OFF, V_{BT} is connected to RET pin (0 V), and the accumulated current is quickly discharged.

Fig. 5.10 shows the polarity of the AC adapter plug.

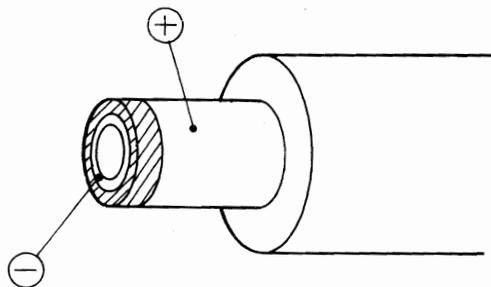


Fig. 5.10 Polarity of the AC Adapter Plug

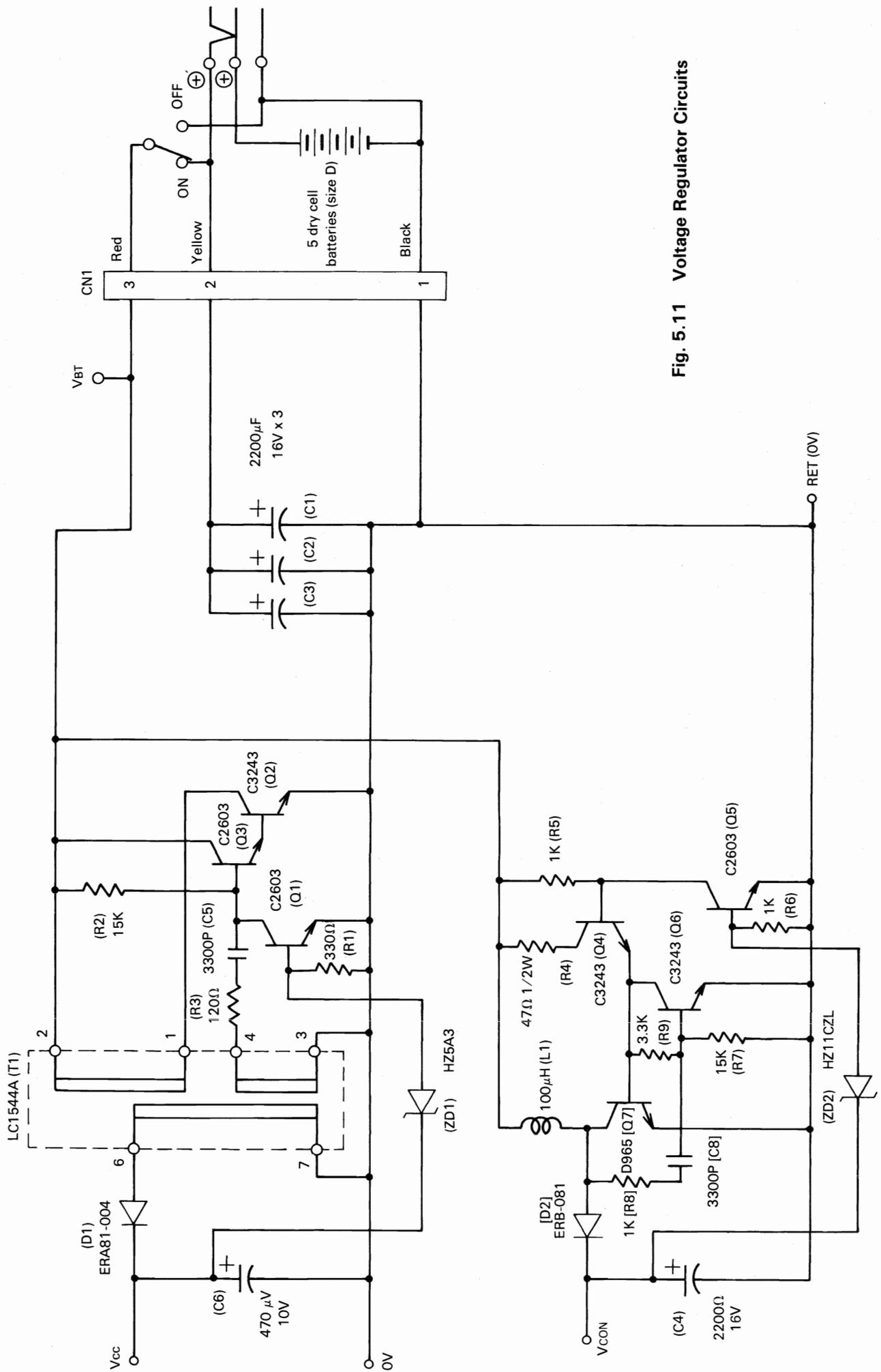


Fig. 5.11 Voltage Regulator Circuits

5.7 Buzzer Drive Circuit

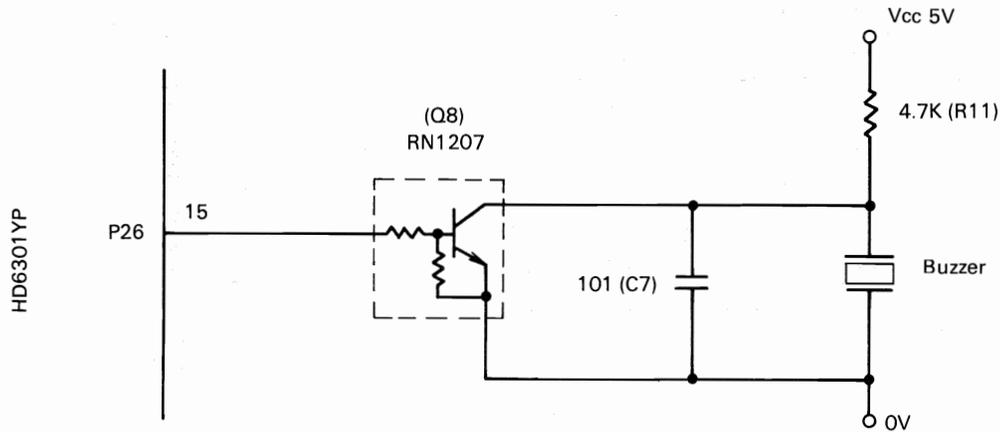


Fig. 5.12 Buzzer Drive Circuit

As shown in Fig. 5.12, the piezo-electric buzzer is controlled by the main CPU. When the main CPU detects a condition which calls for the buzzer to be driven, a pulse train of about 4.4 kHz (the buzzer drive signal) is output from P26 and pulled up to about the Vcc voltage level by transistor Q8 before being applied across the terminals of the piezo-electric buzzer. The buzzer then sounds.

5.8 Low Voltage Detection Circuit

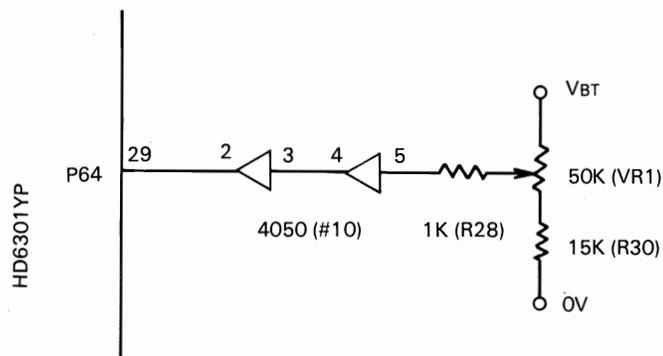


Fig. 5.13 Low Voltage Detection Circuit

Fig. 5.13 shows the low voltage detection circuit.

This circuit informs the main CPU when the voltage has dropped. If V_{BT} drops below 5.5 V when the carriage motor is in high speed drive, pin 2 on IC #10 (4050BP) goes LOW. The main CPU detects this and causes LED (BATTERY LED) to flash.

Whether the V_{BT} voltage is low or not is determined by detecting the potential between voltage regulator VR1 and resistor R28, using the threshold element of IC #10.

5.9 Leaf Switch Detection Circuit

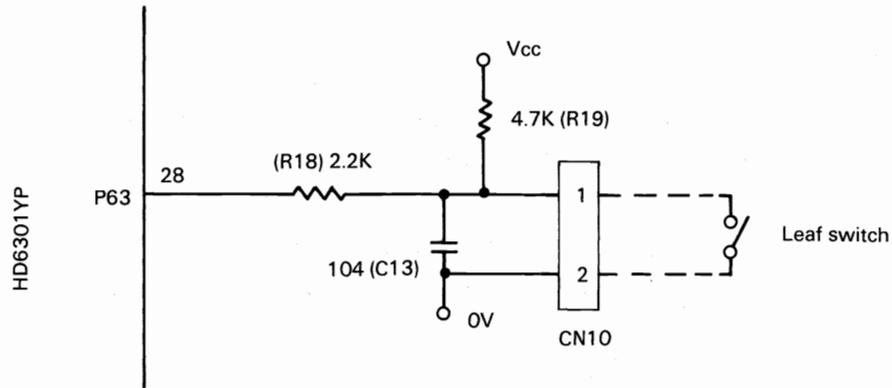


Fig. 5.14 Leaf Switch Detection Circuit

Fig. 5.14 shows the leaf switch detection circuit.

This circuit detects when the carriage is at the home position (it informs the main CPU whether the leaf switch is on or off).

CHAPTER II. TROUBLESHOOTING

GENERAL

This section will help in determining the cause of typewriter malfunctions. However, since it is impossible to predict what problems will occur with a particular typewriter or when they will occur, establishing a failsafe troubleshooting procedure is extremely difficult. This section therefore does no more than guide by reference to example problems. It is recommended that you develop a thorough understanding of the functions of each block so that you can determine approximately where problems have occurred by analyzing and examining them.

1.1 Precautions on Repair

- (1) Thoroughly investigate the problem. If a number of problems have occurred, consider the relationship between them before conducting repairs.
- (2) When dry cell batteries or the AC adapter are used for power supply, the output voltage should be 7-11 V when there is no load.
- (3) When an automatic voltage regulator is used, it should have a rating of 5-9 V and 2 A or more.
- (4) When an automatic voltage regulator is used, take care to ensure correct polarity.
- (5) The power must be switched off before testing for continuity with a multimeter. The electrolytic capacitor C4 (2200 μ F, 16 V) should be discharged before testing for continuity in circuits to which VCON is supplied.
- (6) If a problem occurs with the thermal head or printing mechanism, the thermal head's flexible cable should be kept disconnected until the thermal head drive circuit is working normally.

1.2 Procedure After Repair

After the cause of a problem has been determined and repairs have been made, tests should be conducted to ensure that the problem has been completely remedied.

A record of the troubleshooting procedure should be kept for future reference.

NOTE:

As to the question in the troubleshooting charts, when the answer is yes, the condition is normal. If not, it is abnormal.

TROUBLESHOOTING (1)

Problem	Points to check	Probable cause	Remedy	Repair	Manual reference	
The carriage does not return to the home position when the power is switched on.	Is there voltage applied across RET pin (0V) and V _{BT} pin on the driver PCB?	Loose contact in the power switch	Replace the power switch unit.	Replace the power switch.	5.6 Voltage Regulator Circuits	
		Broken wire in the power switch lead		Replace the power switch lead.		
		Power switch lead improperly soldered		Resolder the lead.		
	Is the V _{cc} voltage 5±0.3V?	V _{cc} voltage regulator circuit defective	Replace the driver PCB assembly.	Check all parts in the V _{cc} voltage regulator circuit.	Check all parts in the RESET circuit.	4.2 RES Signal
		RESET circuit defective				
	Is pin 6 on the main CPU (HD6301YP) HIGH?	Main CPU defective	Replace the main CPU.	Replace IC #3.	Replace IC #1.	5.5 Motor Drive Circuit
		IC #3 defective				
	Is the output from pins 3, 4, 10 and 11 on IC #3 (4081) normal?	NO	IC #1 defective	Replace the carriage motor unit.	Replace IC #3.	Replace IC #1.
			CN3 (connector) defective			
		YES	Carriage motor defective	Replace the carriage motor unit.		
Is the leaf switch operation normal?	NO	Leaf switch unit defective	Replace the leaf switch.	Replace the main CPU.	5.9 Leaf Switch Detection Circuit	
		Main CPU defective				Replace the driver PCB assembly.
	YES	IC #10 defective	Replace the thermal head motor unit.	Replace IC #10.	Replace IC #9.	5.5 Motor Drive Circuit
		IC #9 defective				
	YES	CN4 (connector) defective	Replace CN4.			
The thermal head does not move forward (to contact the paper) or backward (to release itself from the paper) properly.	Is output from pins 51~54 on the main CPU (HD6301YP) normal?	Main CPU defective	Replace the driver PCB assembly.	Replace the main CPU.	5.5 Motor Drive Circuit	
						Is output from pins 6, 10, 12 and 15 on IC #10 (4050BP) normal?
	Is output from pins 12~15 on IC #9 (M54539P) normal?	NO	IC #9 defective	Replace the thermal head motor unit.	Replace IC #9.	
	YES	CN4 (connector) defective	Replace the thermal head motor unit.	Replace CN4.		

TROUBLESHOOTING (2)

Problem	Points to check	Probable cause	Remedy	Repair	Manual reference
Paper feed is not normal.	Is output from pin 27 and pins 55~58 on the main CPU (HD6301YP) normal?	Main CPU defective	Replace the driver PCB assembly.	Replace the main CPU.	5.5 Motor Drive Circuits
	Is output from pins 3, 4, 10, and 11 on IC #2 (4081BP) normal?	IC #2 defective		Replace IC #2.	
		Is output from pins 14 and 15 on IC #1 (M54539P) and pins 10 and 11 on IC #9 (M54539P) normal?		IC #1 or #9 defective	
		YES		CN2 (connector) defective	
Nothing happens when the keys are pressed.	Are any of the keys stuck in the held-down position?	Paper feed motor defective	Replace the paper feed motor unit.		5.1 Key Input Detection Circuit and Indication Circuit
	Are keyboard scanning signals being output from pins 17~25 on the main CPU (HD6301YP)?	Rubber spring defective	Replace the rubber spring.		
	Are keyboard scanning signals input to pins 34~41 on the main CPU (HD6301YP)?	Main CPU defective	Replace the driver PCB assembly.	Replace the main CPU.	
		CN7 or CN8 defective		Replace the defective	
When the power is turned on, LED 1 (BATTERY) neither lights up nor flashes.	Is pin 16 on the main CPU (HD6301YP) HIGH?	Pattern film unit defective	Replace the pattern film unit.		5.3 LED Drive Circuit
	Is the collector for Q9 (RN1207) LOW?	Main CPU defective	Replace the driver PCB assembly.	Replace the main CPU.	
		Q9 defective		Replace Q9.	
		LED 1 defective		Replace LED 1.	
LED 2 (SHIFT LOCK) does not light up during SHIFT LOCK or when the SHIFT key is pressed.	Is pin 16 on the main CPU (HD6301YP) HIGH?	Main CPU defective	Replace the main CPU.	Replace the main CPU.	5.7 Buzzer Drive Circuit
	Is the collector for Q12 (RN1207) LOW?	Q12 defective		Replace Q12.	
		LED 2 defective		Replace LED 2.	
	Is output from pin 15 on the main CPU (HD6301YP) normal?	Main CPU defective		Replace the main CPU.	

TROUBLESHOOTING (3)

Problem	Points to check		Probable cause	Remedy	Repair	Manual reference
	Is output from the collector of Q8 (RN1207) normal?	NO YES				
The buzzer does not sound.	Is output from the collector of Q8 (RN1207) normal?	NO YES	Q8 defective Buzzer defective		Replace Q8. Replace the buzzer.	5.7 Buzzer Drive Circuit
The slide switches do not work.	Are slide switch scanning signals output from pins 59~63 on the main CPU (HD6301YP)?	YES	Main CPU defective	Replace the driver PCB assembly.	Replace the main CPU,	5.1 Key Input Detection Circuit and Indication Circuit
		NO	Flat cable defective Slide switch defective		Replace the flat cable. Replace the slide switch.	
LED 1 does not work properly.	Is VR1 voltage correctly set?		Faulty VR1 setting?	Adjust VR1 setting.		5.8 Low Voltage Detection Circuit
	Is output from pin 2 of IC #10 (4050BP) normal?	NO YES	IC #10 defective Main CPU defective	Replace the driver PCB.	Replace IC #10. Replace the main CPU.	
One particular dot is never printed,	Is the output from ICs #5, #6, and #7 (M54539P) normal?	NO	ICs #5, #6, #7 defective		Replace ICs #5, #6, #7.	5.4 Thermal Head Drive Circuit
		YES	CN9 (connector) defective		Replace CN9.	
Print is faint, or no print appears on the paper.	The thermal head rank and solder point settings do not match.		Thermal head defective	Replace the thermal head.		5.2 Font Specification Setting Circuit and Thermal Head Rank Setting Circuit
			Wrong soldering	Resolder the rank solder points.		
	The thermal head is outside the rank setting.		Thermal head unit defective		Replace the thermal head unit.	
		Is output from pins 9, 10, 11, 13, and 14 on the main CPU (HD6301YP) normal?		Main CPU defective	Replace the driver PCB assembly,	Replace the main CPU.
Is output from pins 6 and 10 on IC #4 (4538P) normal?	Is output from pin 4 on IC #8 (4071BP) normal?	NO	IC #4 defective		Replace IC #4.	5.6 Voltage Regulator Circuits
		YES	IC #8 defective		Replace IC #8.	
		YES	ICs #5, #6, #7 defective		Replace ICs #5, #6, #7.	
Is VCON voltage 12 ±0.3V?			VCON supply voltage regulator circuit defective		Check all parts in the VCON supply voltage regulator circuit.	

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