KENWOOD
HI/FI STEREO COMPONENTS

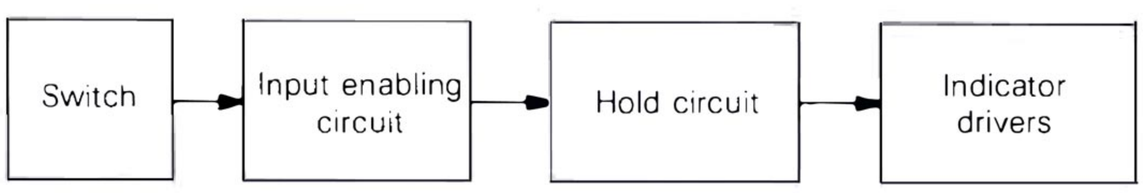
SERVICE MANUAL

KD-4100 SUPPLEMENT

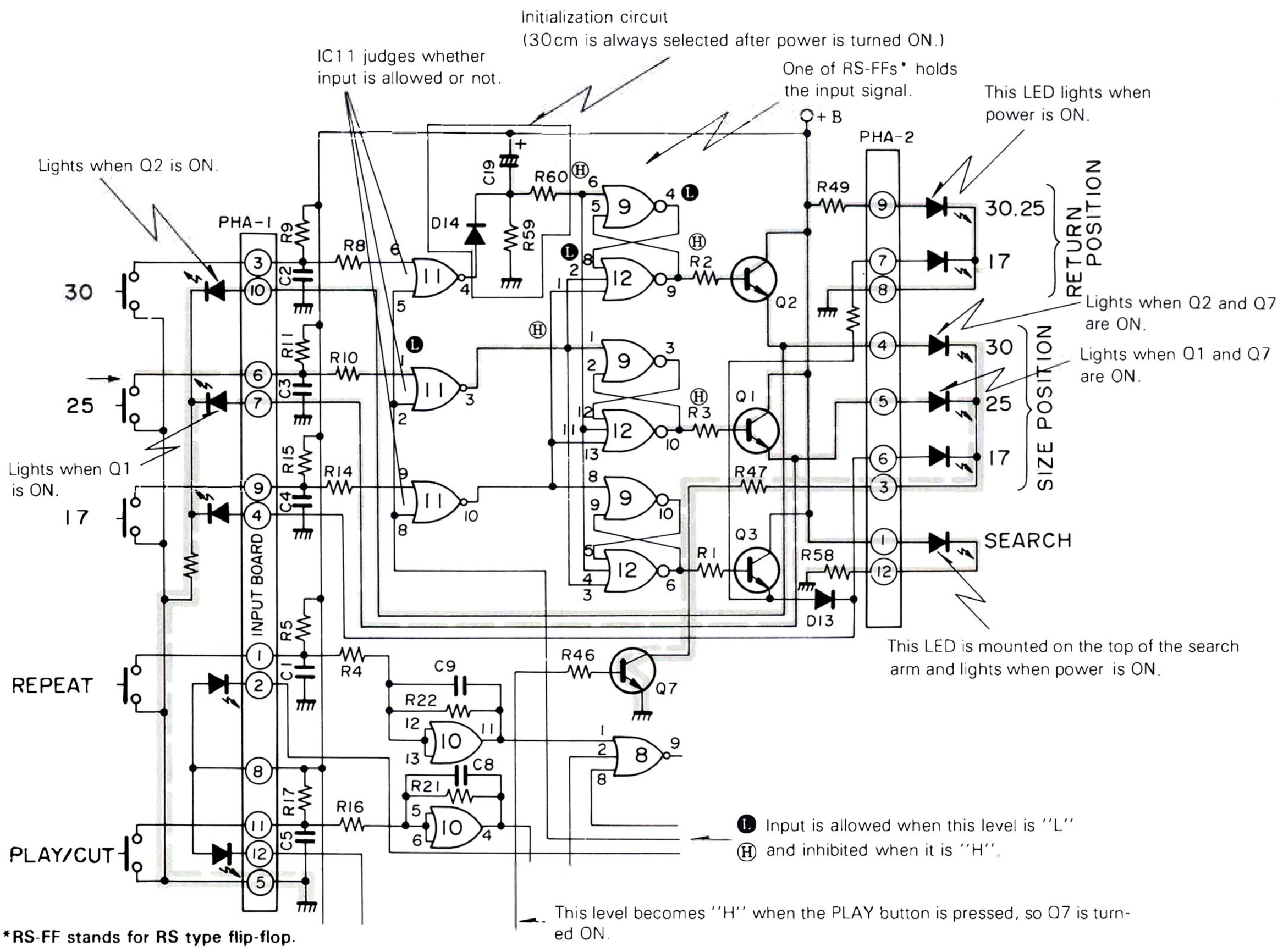
This manual documents mechanical operation of the KD-4100.

Record Size Selection Circuit

Momentary switches which make contact only while they are pressed are used as the record size selection switches in the KD-4100. Therefore, the input signal must be held after the switch has been released. Further, a circuit which inhibits the record size selection under certain conditions is necessary: e.g. while a 30cm record is being played, 25cm and 17cm size selection must be inhibited. The record size selection circuit used in the KD-4100 satisfies the above requirements. Its configuration is as follows.



The record size selection circuit includes a circuit which sets the record size to 30cm when power is turned ON. When power is turned ON, a charging current flows into C19 and +B is applied to Pin 6 of IC9, then Pin 9 of IC12 is set to "H", so that Q2 is turned ON. Q2 drives the 30cm size selection LED (in the POSITION holder, which has 3 LEDs, one for each record size, to let the arm detect the lead-in position.) and the LED built in the 30cm size selection button. When the 25cm size selection button is pressed, Pin 1 of IC11 becomes "L". Pin 3 of IC11 can be "H" only when Pin 2 of IC11 is also "L". When Pin 3 of IC11 is "H", "H" level is applied to Pin 1 of IC9, then Pin 10 of IC12 is set to "H" and Q1 is turned ON. Q1 drives the size selection LED and the LED built in the size selection button. For 17cm size selection, circuit operation is similar to the above.



***RS-FF stands for RS type flip-flop.**

OPERATION OF MECHANISM

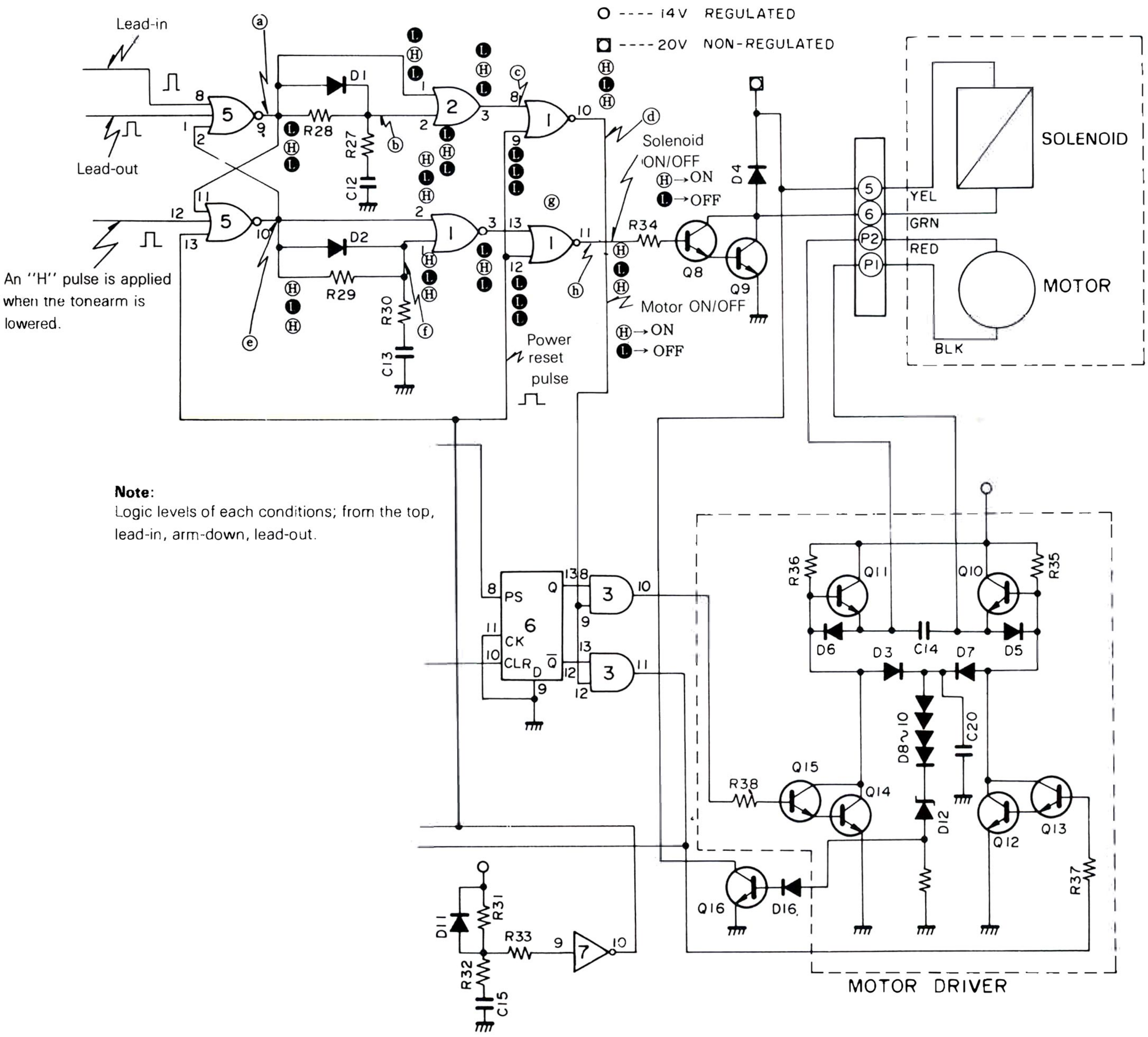
Solenoid and DC Motor Timing Control Circuit

This circuit controls the ON/OFF timing of the solenoid and the arm drive DC motor. That is, the circuit turns the arm drive motor ON after the arm has been fully lifted and turns the solenoid OFF after the arm has reached the lead-in position and the motor has been stopped.

When the PLAY/CUT button is pressed, a pulse with a width of several microseconds is applied to Pin 8 of IC5. Pin 1 of IC5 is normally "L". (A pulse is applied to Pin 1 only when the lead-out signal is generated.) Pin 12 of IC5 is also "L" except when the tonearm is lowered. Pin 13 of IC5 is connected to the power reset circuit, so its level is "L". Because of the above conditions, when a pulse is applied to Pin 8 of IC5, Pin 9 of IC5 drops from "H" to "L". This output is applied directly to Pin 1 of IC2 and also applied to Pin 2 of IC2 via a delay circuit. Therefore, Pin 3 of IC2 becomes "L" a time determined by the time constant after Pin 9 of IC5 drops to "L". This "L" signal is applied to Pin 8 of IC1. Since Pin 9 of IC1 is "L", Pin 10 of IC1 is "H" and the motor is turned ON.

On the other hand, Pin 10 of IC5 is set to "H" by a lead-in pulse. This output is applied directly to Pin 2 of IC1 and also applied to Pin 1 of that via a delay circuit. Then, Pin 3 of IC1 becomes "L" a moment after Pin 10 of IC5 becomes "H". This "L" signal is applied to Pin 13 of IC1 and "L" level is applied to Pin 12 of IC1 from the power reset circuit, thus Pin 11 of IC1 is "H". Therefore, the solenoid is actuated and the tonearm is lowered at the lead-in position.

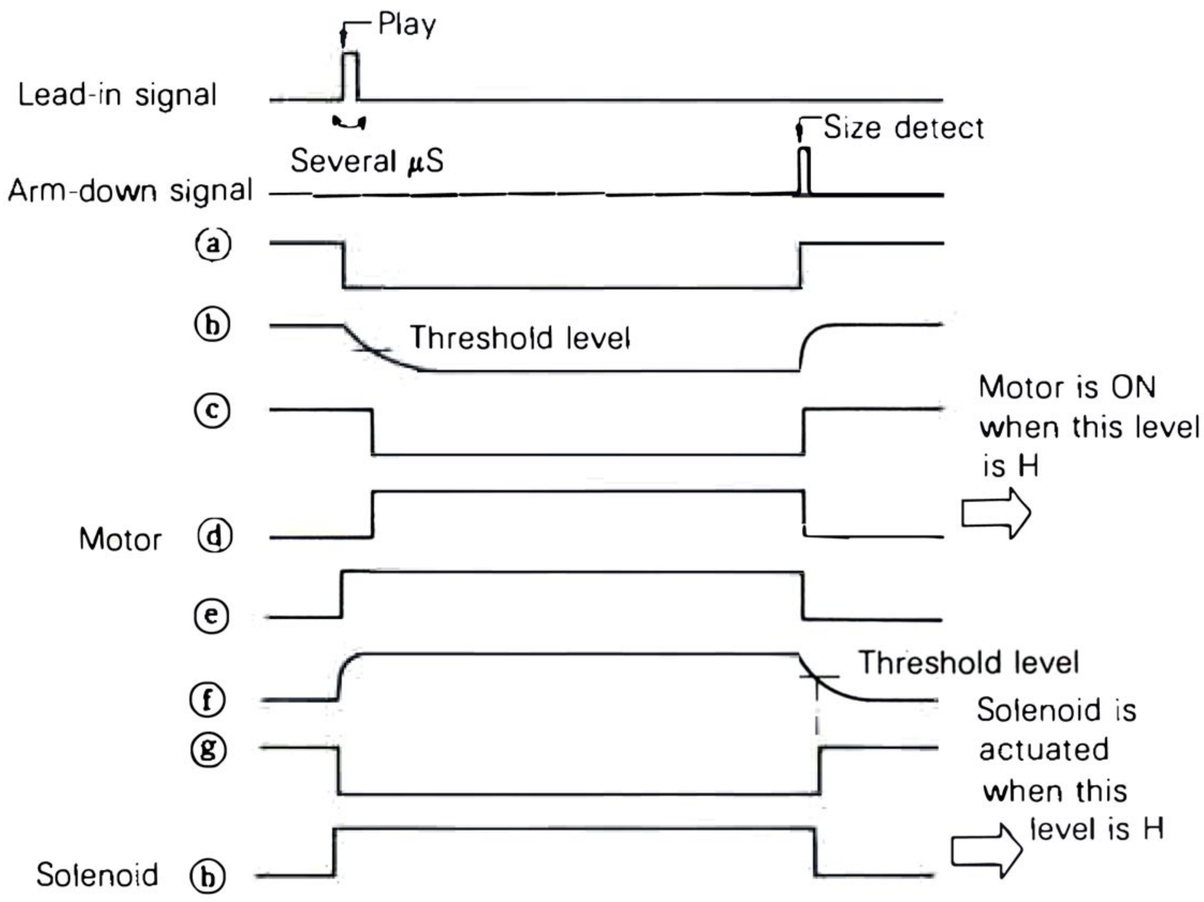
A down signal pulse is applied to Pin 12 of IC5, so that the flip-flop consisting of 2 OR gates in IC5 is inverted from the lead-in state. Then, the signals to the motor and the solenoid become "L" so that the motor stops and the solenoid is turned OFF. Therefore, the idler is released from the sector part of the search arm, resulting in the tonearm becoming free.



Note:
Logic levels of each conditions; from the top, lead-in, arm-down, lead-out.

OPERATION OF MECHANISM

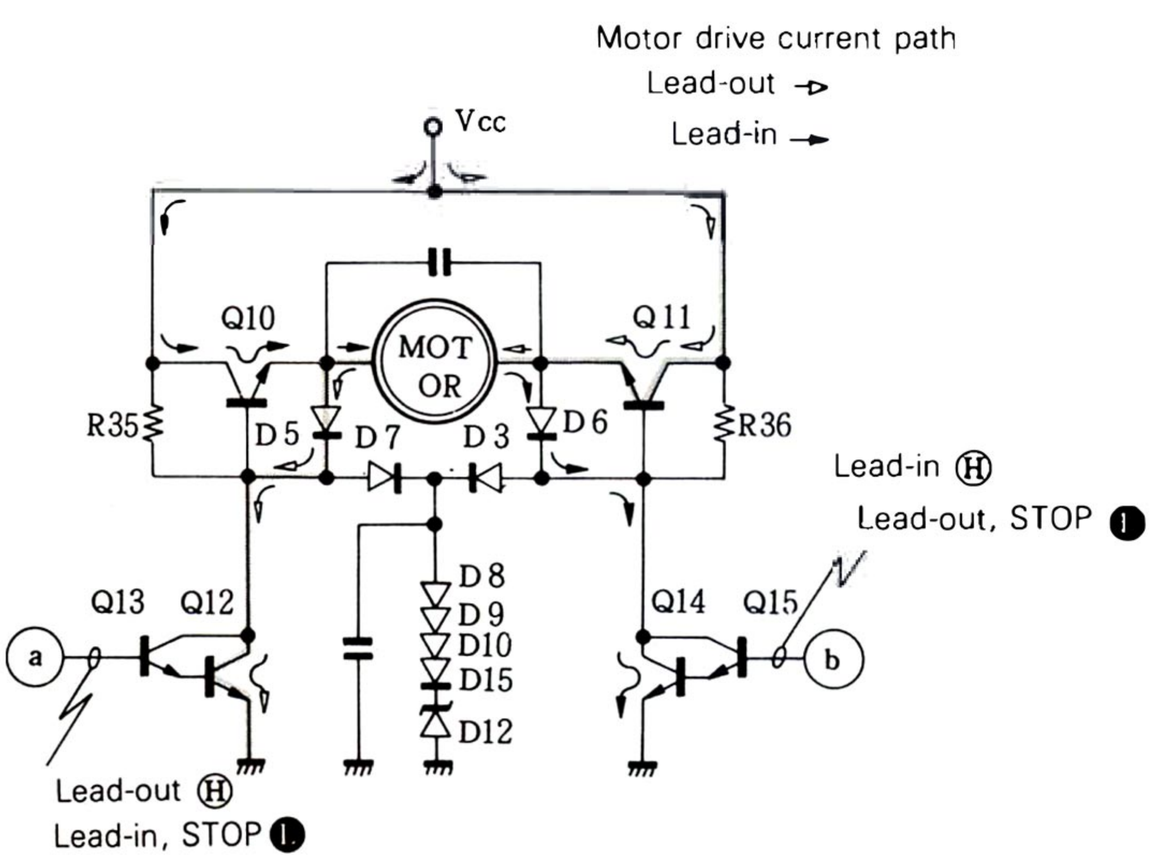
Timing diagram (ⓐ ~ ⓗ) are as follows.



A lead-out pulse is applied to Pin 1 of IC5. This pulse causes the IC5 circuit to operate in the same way as in the lead-in operation, that is, the motor is turned ON and the solenoid is actuated. Therefore, the tonearm is returned to the arm rest. (The DC motor's direction is opposite to that of the lead-in operation.)

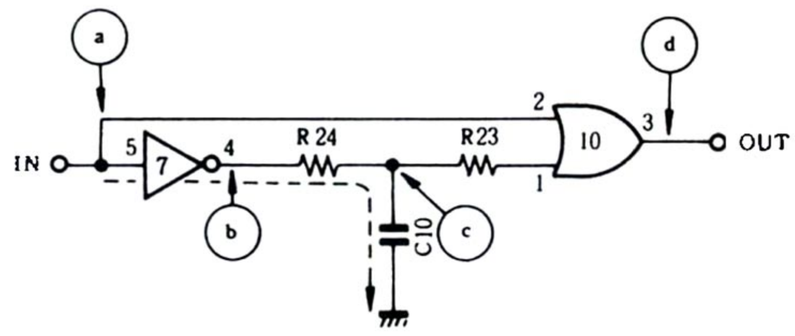
Tonearm Drive DC Motor Drive Circuit

This circuit changes the motor's direction for lead-in or lead-out operation. The circuit changes the motor's direction by switching between two constant current circuits. The drive voltage has a negative temperature characteristic so that the temperature characteristic of the mechanism is compensated. In STOP mode, both levels ⓐ and ⓑ are "L", so Q12 ~ Q15 are OFF and Q10 and Q11 operate in the active region. Therefore, the potentials with respect to GND at both ends of the motor are the same and the motor is stopped.
In lead-in operation, ⓐ is "L" and ⓑ is "H", so Q12 and Q13 are ON and Q14 and Q15 are OFF. Therefore, the drive current flows along the path indicated with the white arrows.

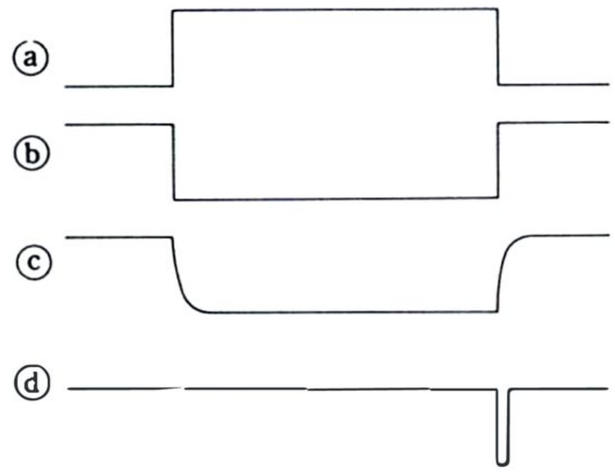


One-shot Multivibrator using C-MOS IC

The PLAY/CUT input signal is applied to the one-shot multivibrator via the Schmitt circuit. The schematic and the timing diagram are shown in the following.



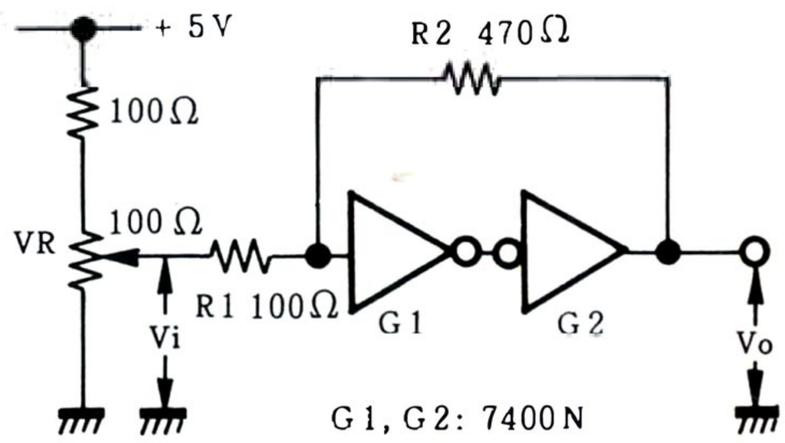
One-shot multivibrator

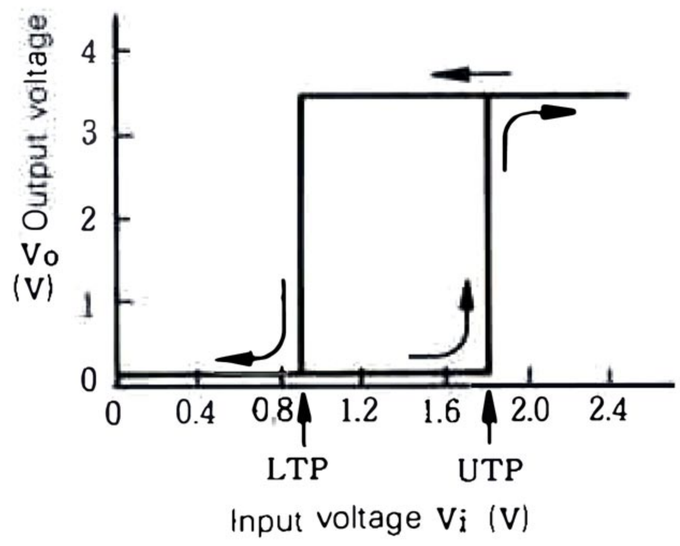


Timing diagram

Schmitt Trigger using C-MOS

The Schimitt trigger circuit is used to remove chattering caused by mechanical switching. The following diagram shows a Schmitt trigger circuit and its output vs. input characteristic curve.

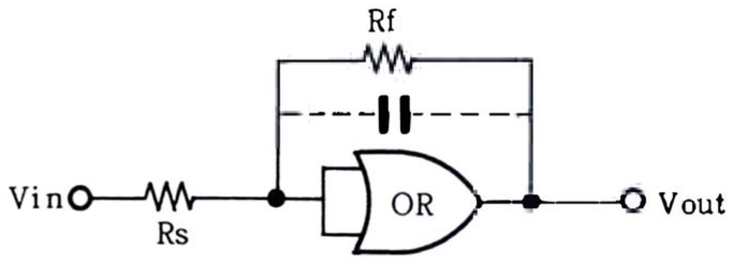




When the input voltage Vi is increased, the output voltage Vo instantaneously rises from "L" to "H" at a certain input voltage called the UTP (Upper Trip Point). Once it rises to "H", Vo stays "H" although Vi is decreased to the UTP till it reaches the lower voltage called the LTP (Lower Trip Point) where it drops instantaneously to "L".

OPERATION OF MECHANISM

In the KD-4100, a Schmitt trigger is formed using an OR gate as shown below.



In this case, UTP and LTP are given by the following equations.

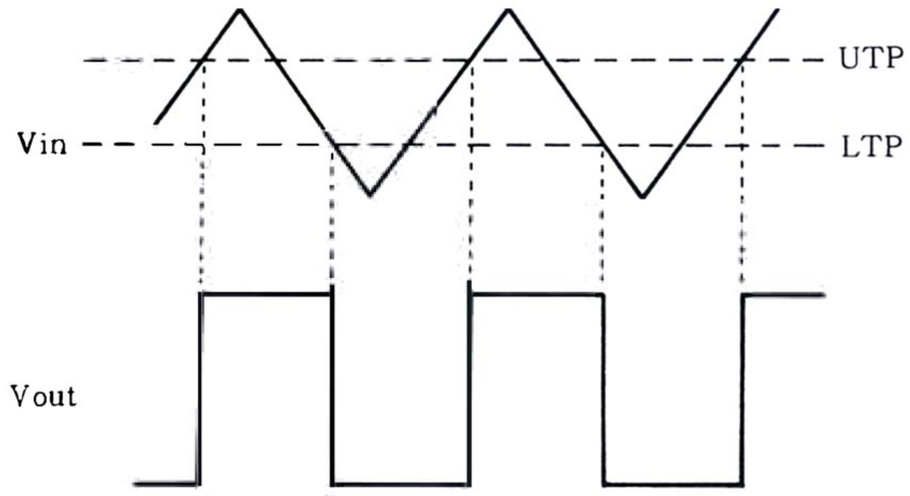
$$UTP = \frac{Rs + Rf}{Rf} \times V_{TH}$$

$$LTP = \frac{Rs + Rf}{Rs} \left(V_{TH} - \frac{Rs}{Rs + Rf} \times V_{DD}\right)$$

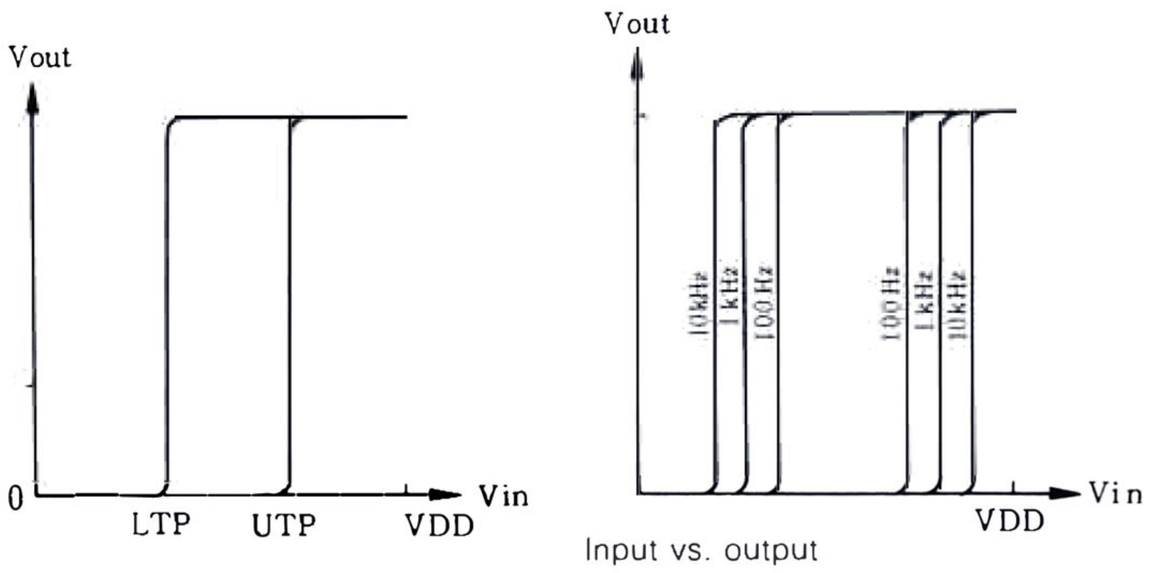
Therefore, the noise margin V_N is given by

$$V_N = UTP \times LTP = \frac{Rs}{Rf} \cdot V_{DD}$$

A small capacitor is connected in parallel with Rf so that the characteristic curve is frequency dependent. As a result, erroneous operations at high frequencies which is caused by noises, etc. are prevented.



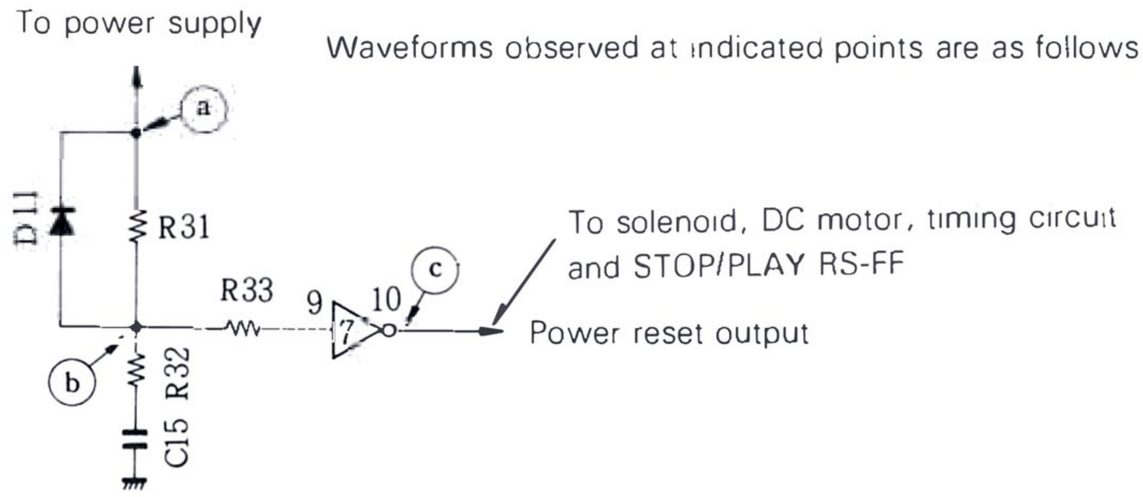
Characteristic curves when a capacitor is connected in parallel.



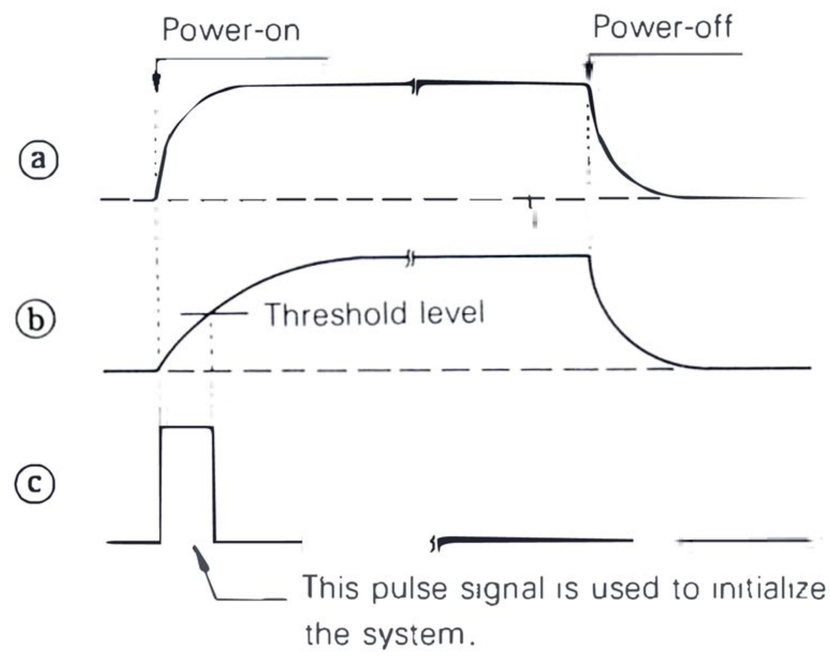
Input vs. output characteristics

Power Reset Circuit (Initializing Circuit)

This circuit initializes the system immediately after the power is turned ON. That is, the turntable platter motor is set in the STOP mode and the REPEAT mode is reset when the tonearm is on the arm rest.



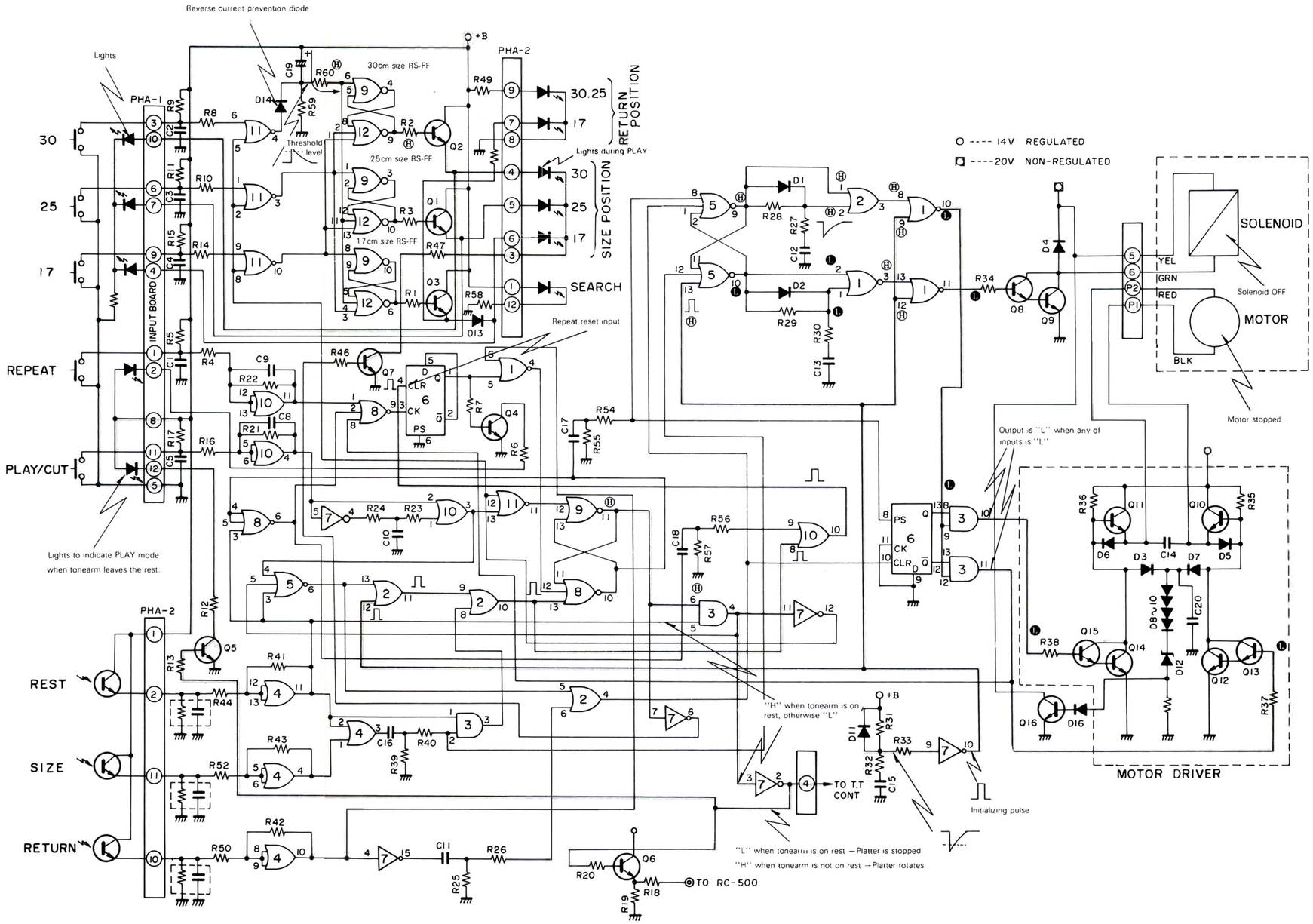
Waveforms observed at indicated points are as follows.



OPERATION OF MECHANISM

Circuit Operation when Power Switch is Turned ON

The output (Pin 10) of inverter IC7 rises immediately after the power switch is turned ON. However, the voltage at Pin 9 gradually increases because of C15. The input logic level is ''L'' until it reaches the threshold level, then changes to ''H''. Therefore, the output level drops to ''L''. Thus, an initializing signal with a ⎍ waveform is obtained at Pin 10 of IC7.
This pulse is applied to the solenoid and the DC motor timing control circuit to set the solenoid and the DC motor to the OFF state. This pulse also sets the turntable system to the STOP mode and resets the REPEAT mode. The record size selection circuit is individually initialized by another circuit consisting of C19, R59 and R60. For details of this circuit, refer to ''Record Size Selection Circuit''.



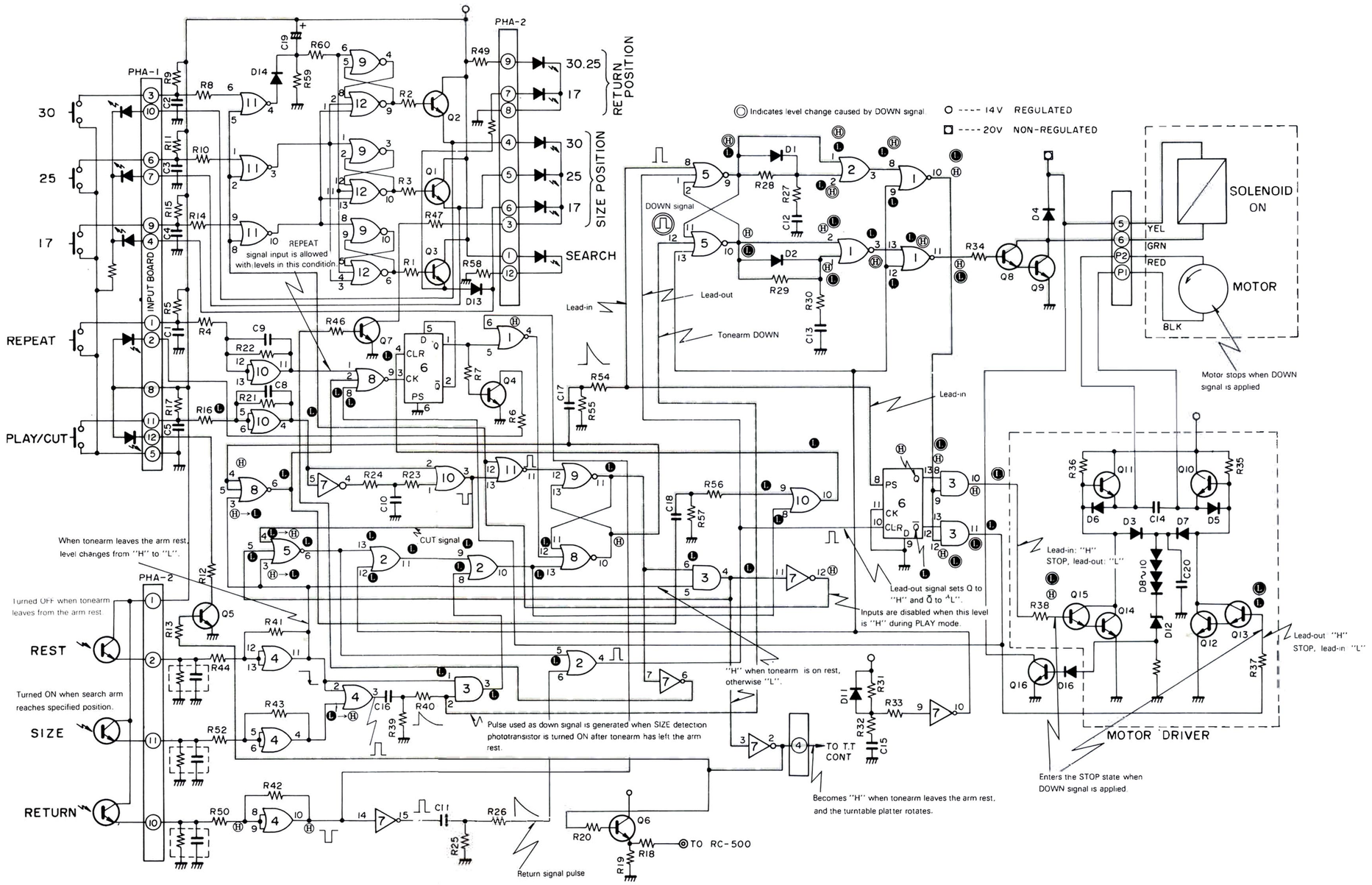
OPERATION OF MECHANISM

Circuit Operation when PLAY/CUT Button is Pressed

When the PLAY/CUT button is pressed, Pins 5,6 of IC10 (Schmitt trigger) become "L" for a time while the PLAY/CUT switch makes contact. Therefore, a negative square pulse (⊓⊔) appears at Pin 4 of IC10. This pulse is applied to the one-shot multivibrator to generate a narrow negative pulse. This narrow pulse output from Pin 3 of IC10 is applied to the RS type flip-flop (abbreviate as RS-FF from hereon) after whether or not input is allowed has been checked. When a pulse is applied to the RS-FF, its output, Pin 10 of IC8, rises to "H". This "H" signal is applied to the solenoid and the DC motor timing circuit as a lead-in signal. This "H" signal is also applied to the REPEAT circuit to enable the REPEAT button signal to be input.

On the other hand, the other output of the RS-FF, Pin 11 of IC9, is "L". This "L" signal is used as a PLAY signal to start the turntable platter and light the LED built in the PLAY/CUT button. Thus, the auto-in operation starts. When the tonearm reaches the specified position, the phototransistor (SIZE) in the search arm is turned ON, so that a pulse is applied to Pin 12 of IC5. Then the RS-FF consisting of IC5 which has been in the lead-in state is inverted to the PLAY state, thus the solenoid and the DC motor are both turned OFF.

At the end of the record, the tonearm reaches the RETURN position and the shutter comes in between the LED installed in the return holder and the phototransistor on the search arm, as a result the phototransistor is turned OFF. Therefore, a pulse appears at Pin 10 of IC4. This pulse is applied to the REPEAT circuit (IC1), then applied to Pin 12 of IC8 to reset the RS-FF. The pulse output from Pin 10 of IC4 is also applied to the solenoid and the DC motor timing circuit to turn the solenoid and the DC motor ON. In this case, the DC motor current flows in the opposite direction to that of the lead-in operation, so the motor rotates in the reverse direction. The tonearm is returned to the arm rest and the motor and the solenoid are turned OFF.



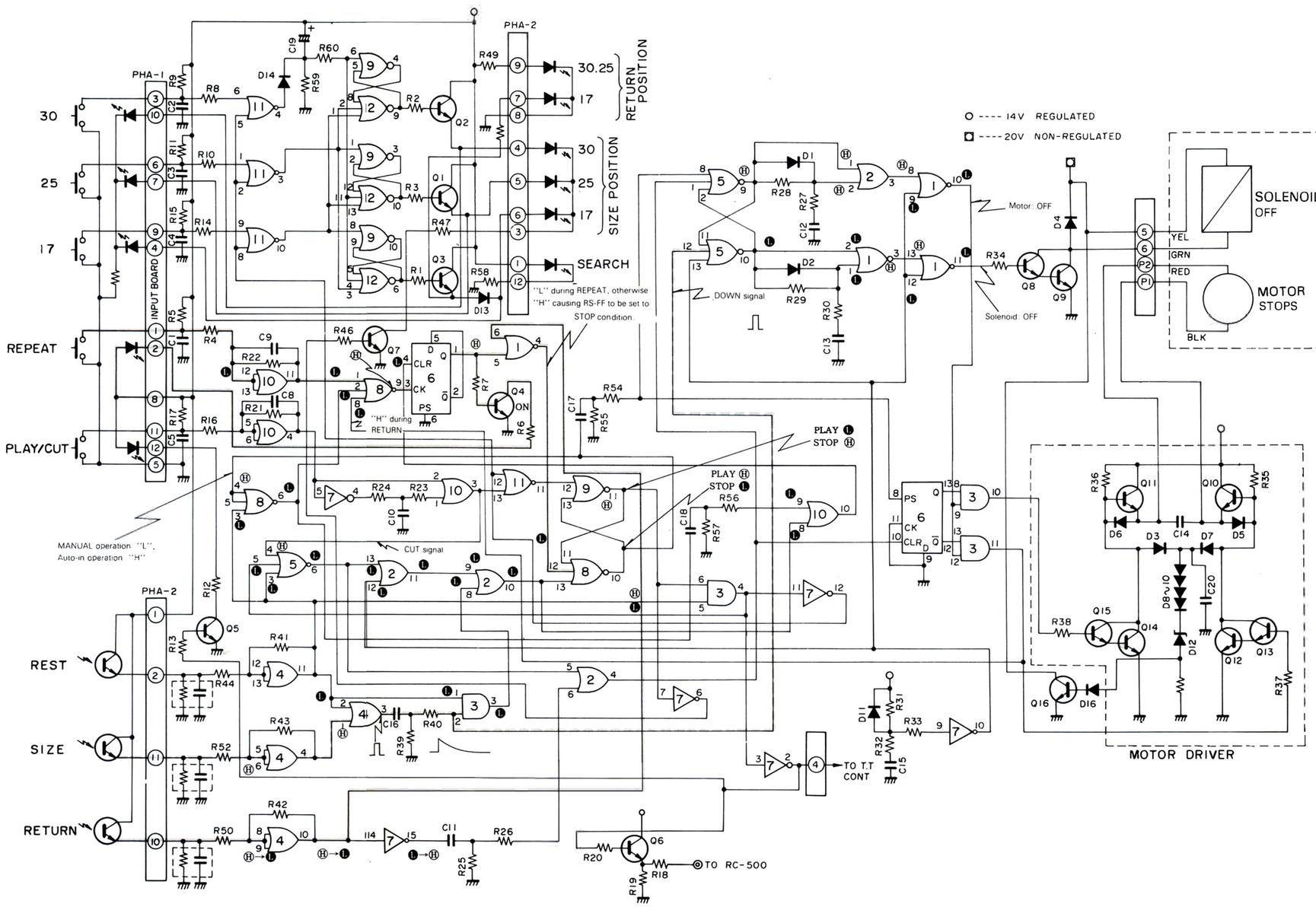
OPERATION OF MECHANISM

Circuit Operation when REPEAT Button is Pressed

When the REPEAT button is pressed, a negative pulse (⊔) appears at Pin 11 of IC10. This pulse is applied to IC8 together with the MANUAL/AUTO signal and lead-out signal. Only when all the applied signal are "L", a pulse is applied to IC6 so that its output Q and $\bar{Q}$ are inverted, making the REPEAT operation possible.

The REPEAT operation is the same as the PLAY operation. When a negative pulse (⊔) is applied to Pin 6 of IC1 during ordinary RETURN operation, a positive pulse (⊓) appears at Pin 4. Then the RS-FF consisting of IC8 and IC9 is inverted from the PLAY condition to the STOP condition. However, when the REPEAT button is pressed, Pin 5 of IC1 is kept "H" (until the REPEAT condition is reset). Therefore, Pin 4 of IC1 is always "L" regardless of the RETURN pulse, so that the RS-FF maintains the PLAY condition.

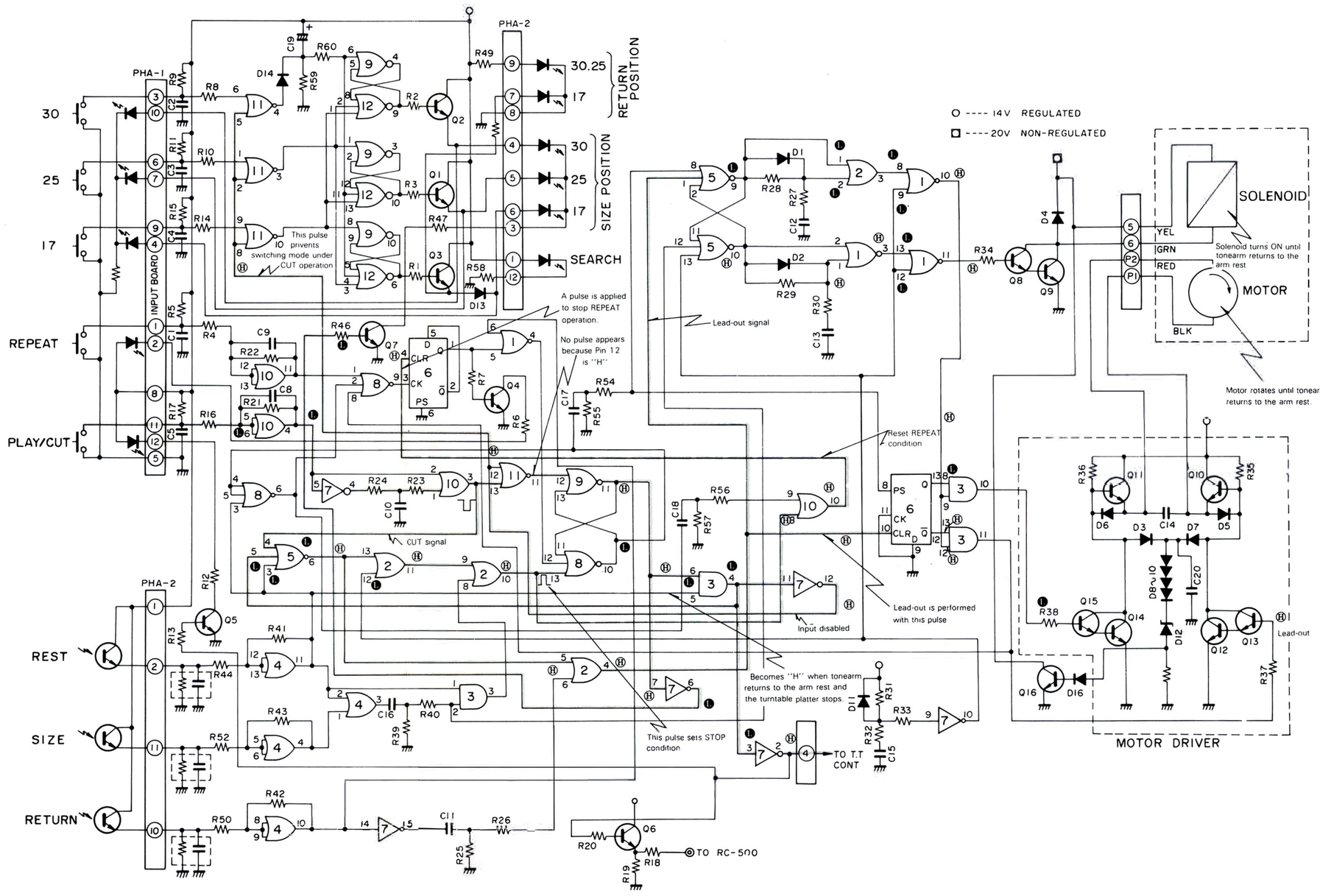
While the tonearm is returning to the arm rest, the SIZE phototransistor receives light from the SIZE position LED (which is built in the POSITION holder) and a DOWN signal pulse is applied to Pin 12 of IC5. Then, the solenoid and the DC motor are turned OFF and the tonearm is stopped at the lead-in position and the record is replayed. The above operation is repeated until the REPEAT condition is reset.



OPERATION OF MECHANISM

Circuit Operation when CUT Button is Pressed

When the CUT button is pressed while playing, a pulse appears at Pin 3 of IC10 as well as in PLAY operation. This pulse is a lead-out signal and resets the REPEAT condition. The pulse is also applied to the RS-FF consisting of IC8 and IC9 so that this RS-FF is set to the STOP condition. The output of the RS-FF turns the size selection LED OFF and disables SIZE selection inputs (button switches).



OPERATION OF MECHANISM

Repair Notes

1. The sensors may function erroneously when exposed to light.
   Shield the phototransistors from the extraneous light when repairing the turntable with the bottom cover removed.
2. Check the operation input circuit board and the sensor circuit board before checking the mechanism control circuit board.

2-1 Key switches

The resistance of PLAY/CUT, REPEAT, 30, 25 and 17cm switches becomes less than 1 kΩ when they are pressed. Therefore, the voltage at each switch output terminal PHA-1 becomes "L" because the supply voltage is divided with 56 kΩ and the above resistance. On the other hand, when the switches are not pressed, the supply voltage appears at each switch output terminal.

2-2 Phototransistors

In the KD-4100, three phototransistors are used for SIZE detection in the search arm, REST detection and RETURN detection. Check if their emitter level changes between "H" and "L" when the light input is turned ON and OFF. (For RETURN detection, shield the phototransistor from the light.)

2-3 LEDs

LEDs are used in the following positions.

1. Top of search arm ×1
2. SIZE holder ×3
3. RETURN holder ×2

These LEDs operate as follows.

LED on the top of search arm	Always lights when power is ON.
LEDs on the SIZE holder	Only one for selected size lights.
LEDs on the RETURN holder	17cm LED lights only when 17cm is selected, otherwise 25/30cm LED lights.

The output states of ICs in all condition of the mechanism control circuit are listed on the next page. Operate the turntable according to the steps 1 ~ 17 and 18 ~ 29 in the table and check the output states of ICs to find defective parts.

Symbols

*: Narrow pulse
**: Very narrow pulse
↑↓ or ↓↑: The level becomes "L" or "H" for a short time
: (or while a switch is pressed).
↘ or ↗ : The level changes continuously.

Note:

To observe a waveform indicated with * or ** with an oscilloscope, turn the brightness up and set the sweep speed appropriately so that a pulse with a width of 5 ~ 10 μs can be observed.

Operation of Turntable (for Checking)

1. Right after the power turned ON
2. After a while from above
3. When 25cm size selection button is pressed
4. When 17cm size selection button is pressed
5. When REPEAT mode is set
6. When REPEAT mode is reset
7. When PLAY button pressed for AUTO PLAY
8. Tonearm: UP
9. When DC motor starts
10. Record SIZE detection
11. Tonearm: DOWN
12. PLAY
13. RETURN detection
14. Tonearm: UP
15. When DC motor starts
16. Rest: IN (When search arm detects REST)
17. Tonearm DOWN
18. When in AUTO PLAY with REPEAT set
19. RETURN detection
20. Tonearm: UP
21. DC motor: ON
22. SIZE detection
23. Tonearm: DOWN
24. When CUT button pressed for AUTO CUT
25. Tonearm: UP
26. DC Motor: ON
27. REST detection
28. Tonearm: DOWN
29. Manual PLAY

OPERATION OF MECHANISM

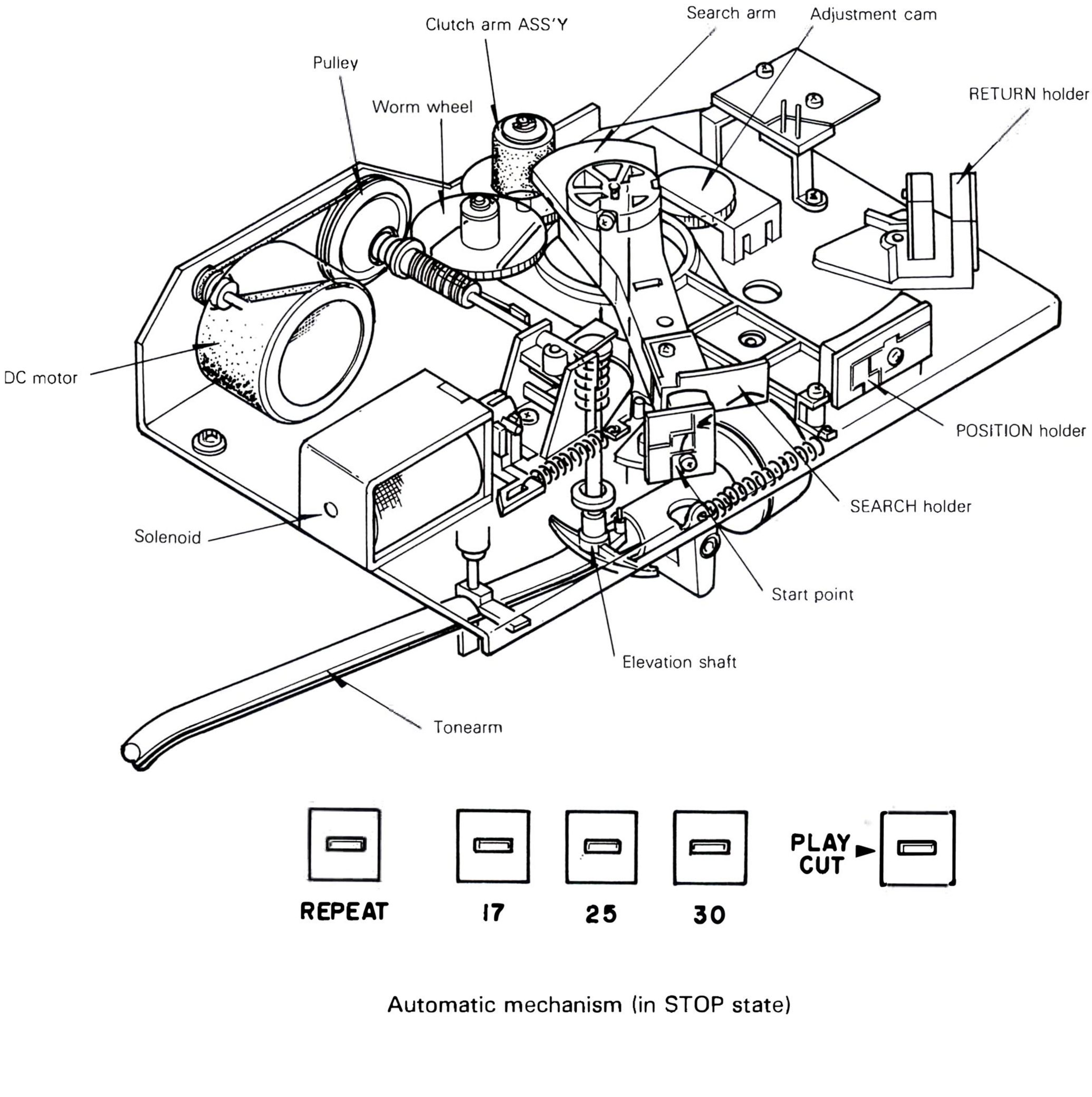
Note:
All the levels are "L" unless specified.

IC No.	PIN No.	CONDITION																											
		①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩	⑪	⑫	⑬	⑭	⑯	⑯	⑰	⑱	⑲	⑳	㉑	㉓	㉓	㉔	㉕	㉖	㉗	㉘	㉙
1	3	H	H	H	H	H	H↓				H↗	H	H↓				H↗	H	H↓				H↗	H↓				H↗	H	
	4													↑H↓																
	10									↑H↓						↑H↓						↑H↓					↑H↓			
	11							↑H	H	H	H↘				↑H	H	H↘			↑H	H	H	H↘	↑H	H	H	H↘			
2	3	H	H	H	H	H	H	H	H↓	↑H	H	H	H	H	H↓		↑H	H	H	H	H↓		↑H	H	H	H↓		↑H	H	
	4													↑H↓**						↑H↓**					↑H↓**				
	10																↑H↓**								↑H↓**			↑H↓**	
	11	H↓																							↑H↓**				
3	3																↑H↓**											↑H↓**	
	4	H	H	H	H	H	H↓										↑H	H										↑H	H	
	10									↑H↓																			
	11															↑H↓						↑H↓		↑H	H↓				
4	3	H	H	H	H	H	H	H	H↓	↑H↓							↑H	H					↑H↓					↑H	H	
	4									↑H↓													↑H↓						
	10	H	H	H	H	H	H	H	H	H	H	H	H↓		↑H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	
	11	H	H	H	H	H	H	H	H↓							↑H	H	H										↑H	H	
5	6																								↑H**				
	9	H	H	H	H	H	H				↑H	H	H↓			H	↑H	H	H↓		↑H	H	H				H	H	H	
	10							↑H	H	H↓				↑H	H					H	H			↑H	H					
6	1				↑H↓														H	H	H	H	H	H↓						
	2	H	H	H	H↓	↑H	H	H	H	H	H	H	H	H	H	H	H	H							↑H	H	H	H	H	
	12	H	H	H	H	H	H↓							↑H	H	H	H	H		↑H	H	H	H	H	H	H	H	H	H	
	13							↑H	H	H	H	H	H↓						H↓											
7	2							↑H	H	H	H	H	H	H	H	H↓			H	H	H	H	H	H	H	H	H↓			
	4							↑H↓																	↑H↓				
	6							↑H	H	H	H	H	H↓						H	H	H	H	H	H	H↓					
	10	H↓																											
	12							↑H	H	H	H	H	H	H	H	H↓			H	H	H	H	H	H	H	H	H↓			
	15													↑H↓						↑H↓									
8	6																												H
	9				↑H↓	↑H↓																								
	10							↑H	H	H	H	H	H↓						H	H	H	H	H	H	H↓					
9	3	H	H↓		↑H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	
	4			↑H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	
	10	H	H	H↓																										
	11	H	H	H	H	H	H↓							↑H	H	H	H	H						↑H	H	H	H	H		
10	3	H	H	H	H	H	H↓	*H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H↓		↑H	H	H	H		
	4	H	H	H	H	H	H↓	↑H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H↓		↑H	H	H	H		
	10	H↓												↑H*			↑H*							↑H*			↑H*			
	11	H	H	H	H↓	↑↓		↑H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H		
11	3			↑H↓																									
	4																												
	10				↑H↓																								
	11													↑H**															
12	6					↑H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	
	9	H	H↓																											
	10			↑H↓																									

OPERATION OF MECHANISM

Operation of Automatic Mechanism

The automatic mechanism is shown below.



Automatic mechanism (in STOP state)

OPERATION OF MECHANISM

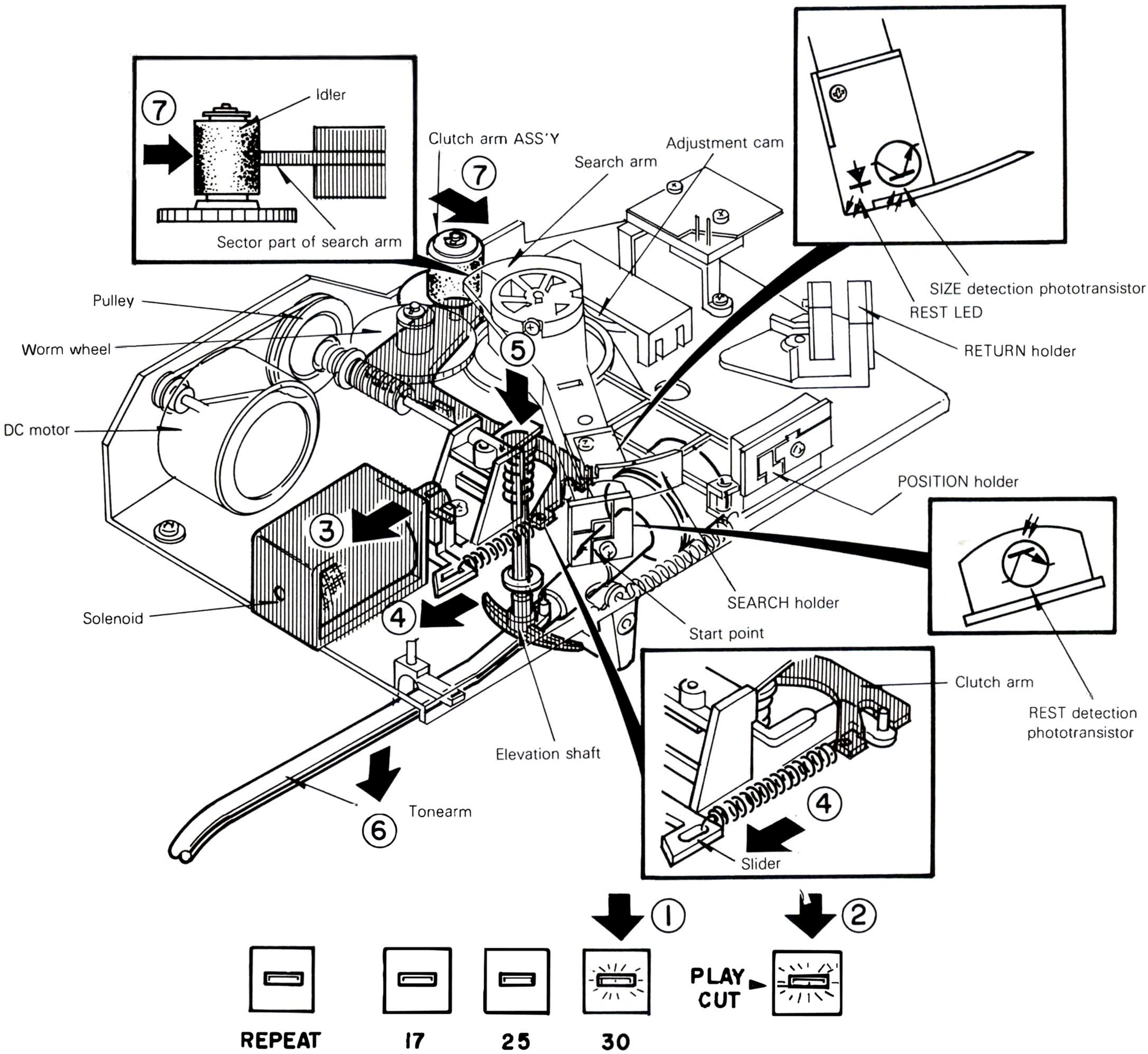
Lead-in detection

1. The record size is selected. (30cm is selected in the following diagram.)
2. The PLAY button is pressed.
3. The solenoid is actuated.
4. The solenoid is moved in the direction of the arrow by the solenoid pin. At the same time, the clutch arm is drawn in direction ④ by the spring.
5. The leaf spring mounted on the guide base presses against the elevation shaft.
6. The elevation arm is lifted up, so that the tonearm is lifted from the arm rest.
7. The clutch arm is drawn by the spring and its sector part contacts the idler.

Note:

When the arm lifter is in the ▼ (UP) position, the solenoid is being forcibly drawn and the slip mechanism functions, thus the intermediate gear races.

When the PLAY button is pressed with the tonearm clamped to the arm rest, the slip mechanism functions. Set the arm lifter to the ▼ (DOWN) position in the former case and turn the power off or release the clamp in the latter case.



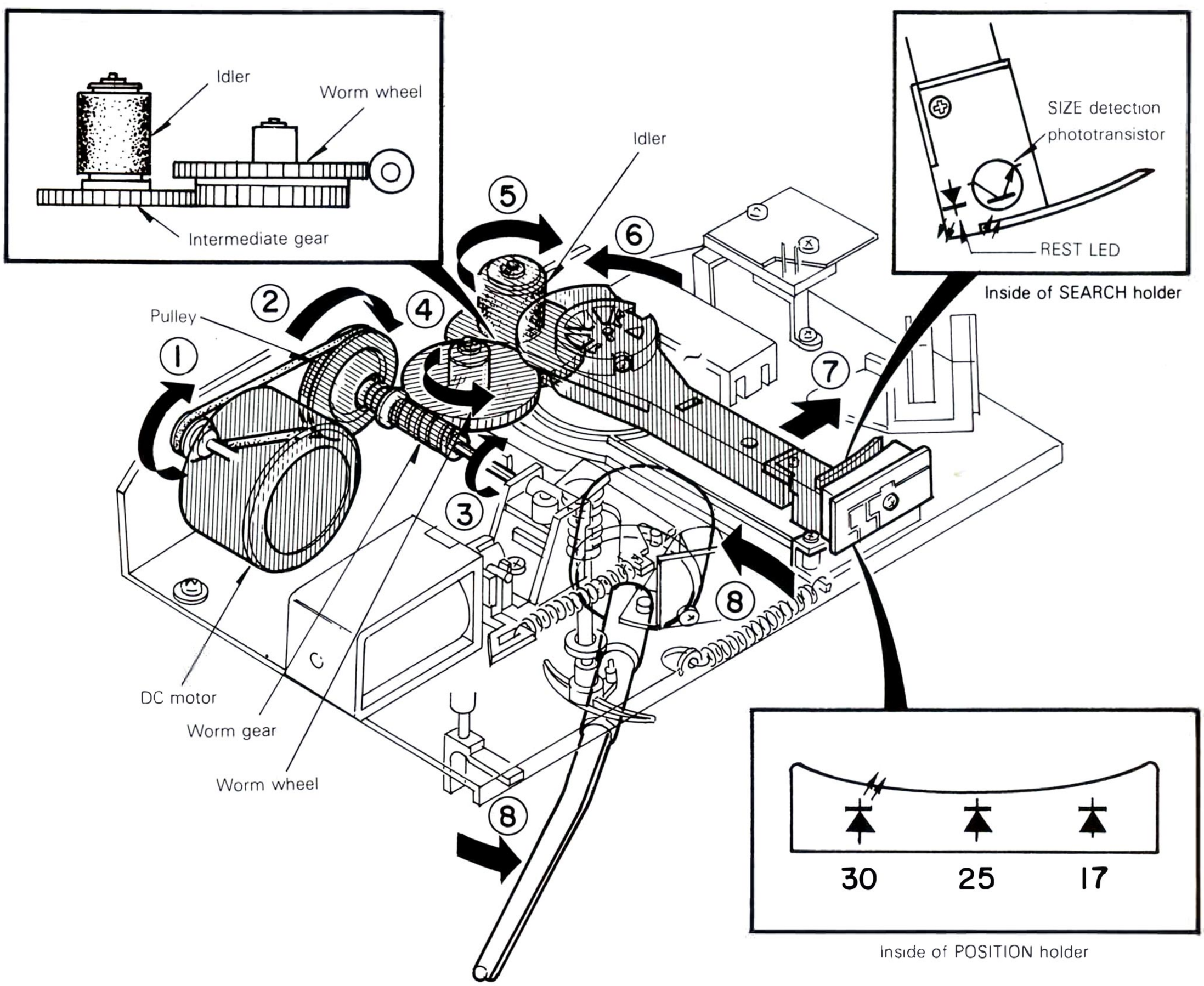
. PLAY state

OPERATION OF MECHANISM

Operation between Lead-in and SIZE

With the sector part of the search arm in contact with the idler:

1. DC motor rotates in the direction of the arrow.
2. Pulley is rotated via the belt.
3. The worm gear attached to the pulley shaft rotates.
4. The rotation of the worm gear is transferred to the worm wheel.
5. The rotation of the worm wheel is transferred to the idler via the intermediate gear.
6. The search arm moves since it is in contact with the idler.
7. The search arm stops when the SIZE detection phototransistor in the SEARCH holder receives light from the LED in the POSITION holder.
8. The tonearm moves in the same way as the search arm.



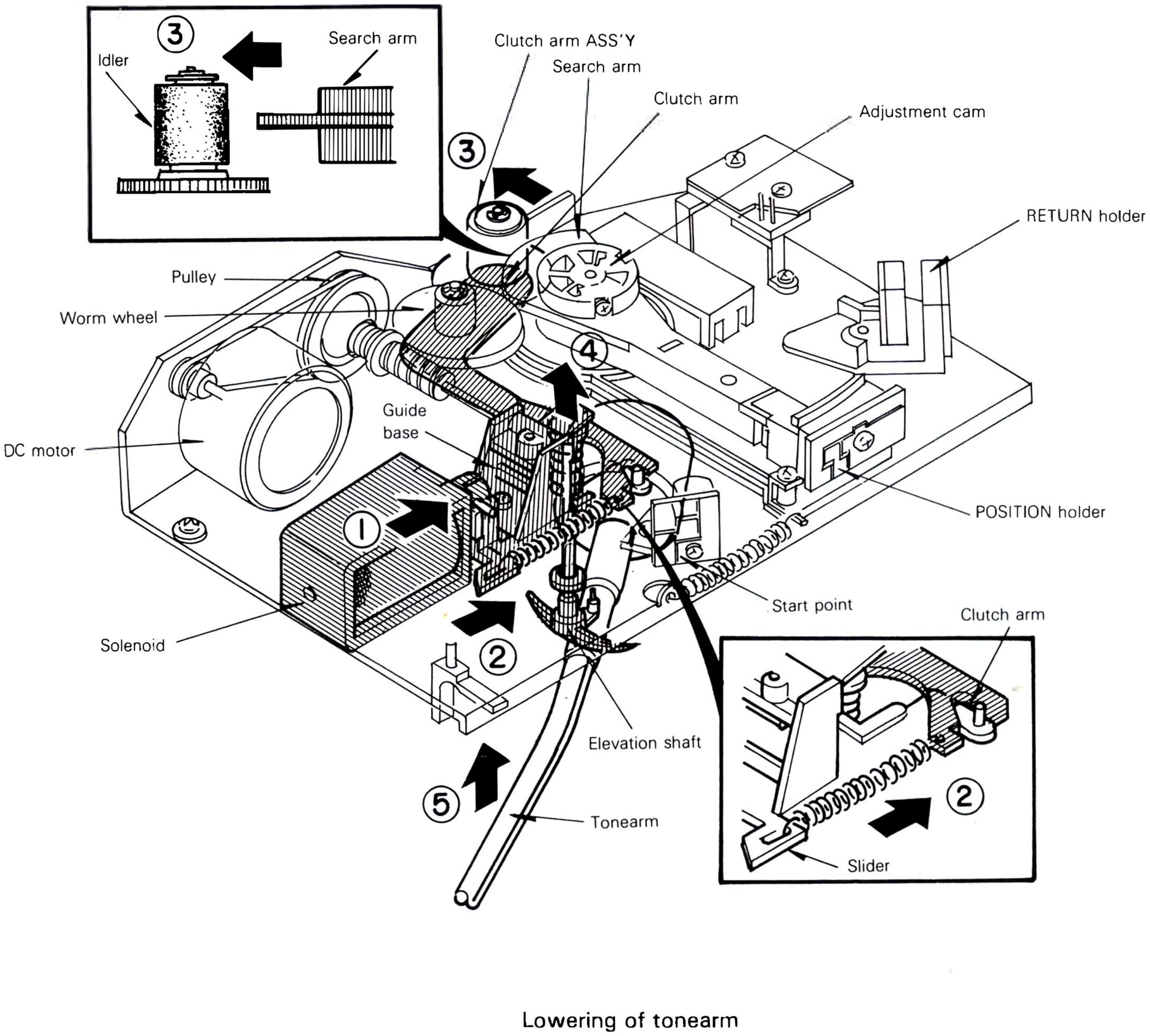
SIZE detection

OPERATION OF MECHANISM

Operation between SIZE Detection and PLAY

When the SEARCH holder reaches the POSITION holder:

1. The solenoid is turned OFF.
2. Clutch arm returns to its original position.
3. The idler separates from the sector part of the search arm.
4. The slider returns to the original position and the elevation shaft is lowered.
5. The tonearm is lowered.

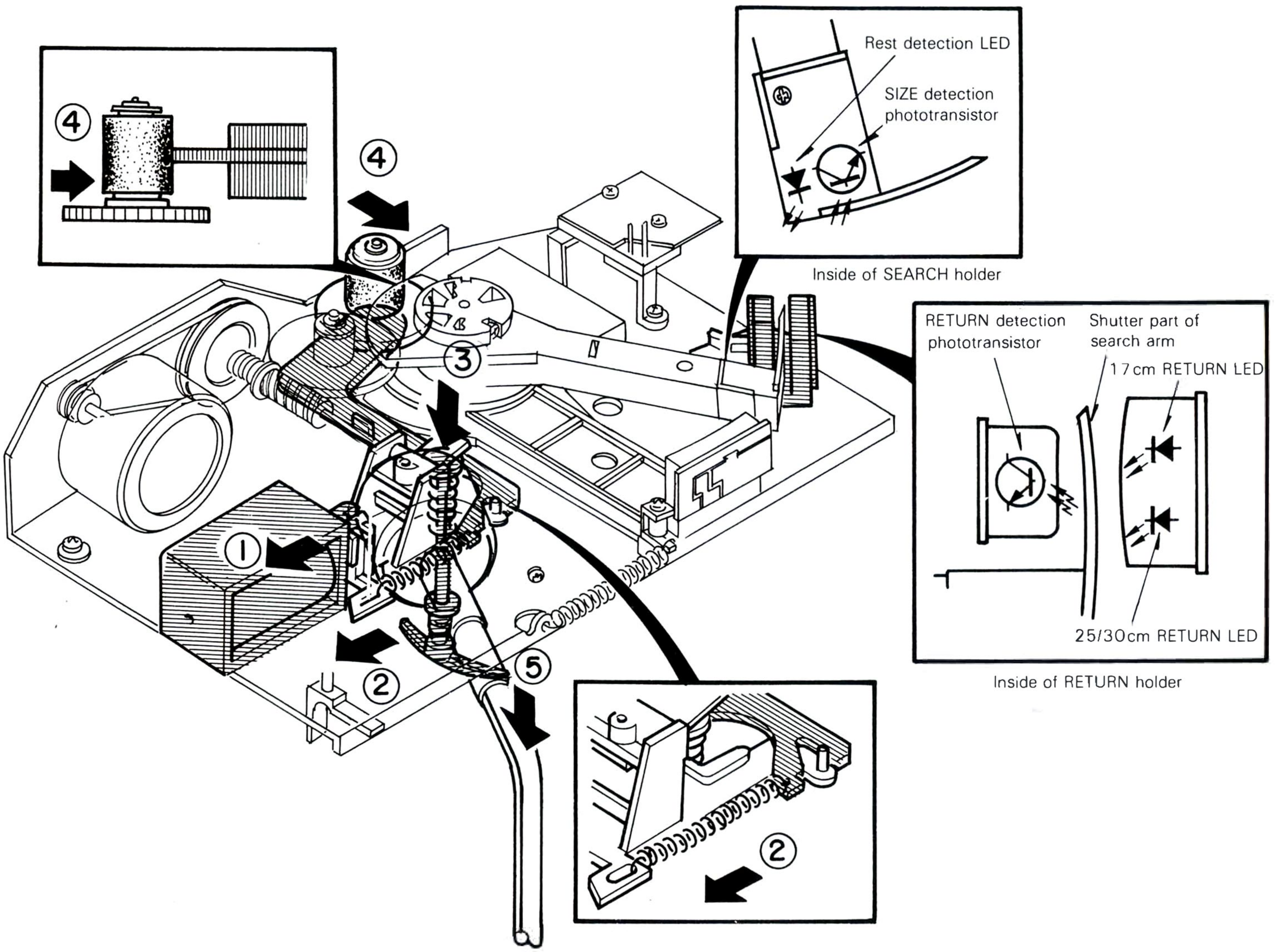


Lowering of tonearm

OPERATION OF MECHANISM

Lead-out Detection

When a record finishes, the tonearm moves further inward and the shutter of the search arm turns OFF the RETURN detection phototransistor. Then, the solenoid is actuated in the same way as the lead-in operation and the search arm comes into contact with the idler.
(Refer to "Lead-in detection".)

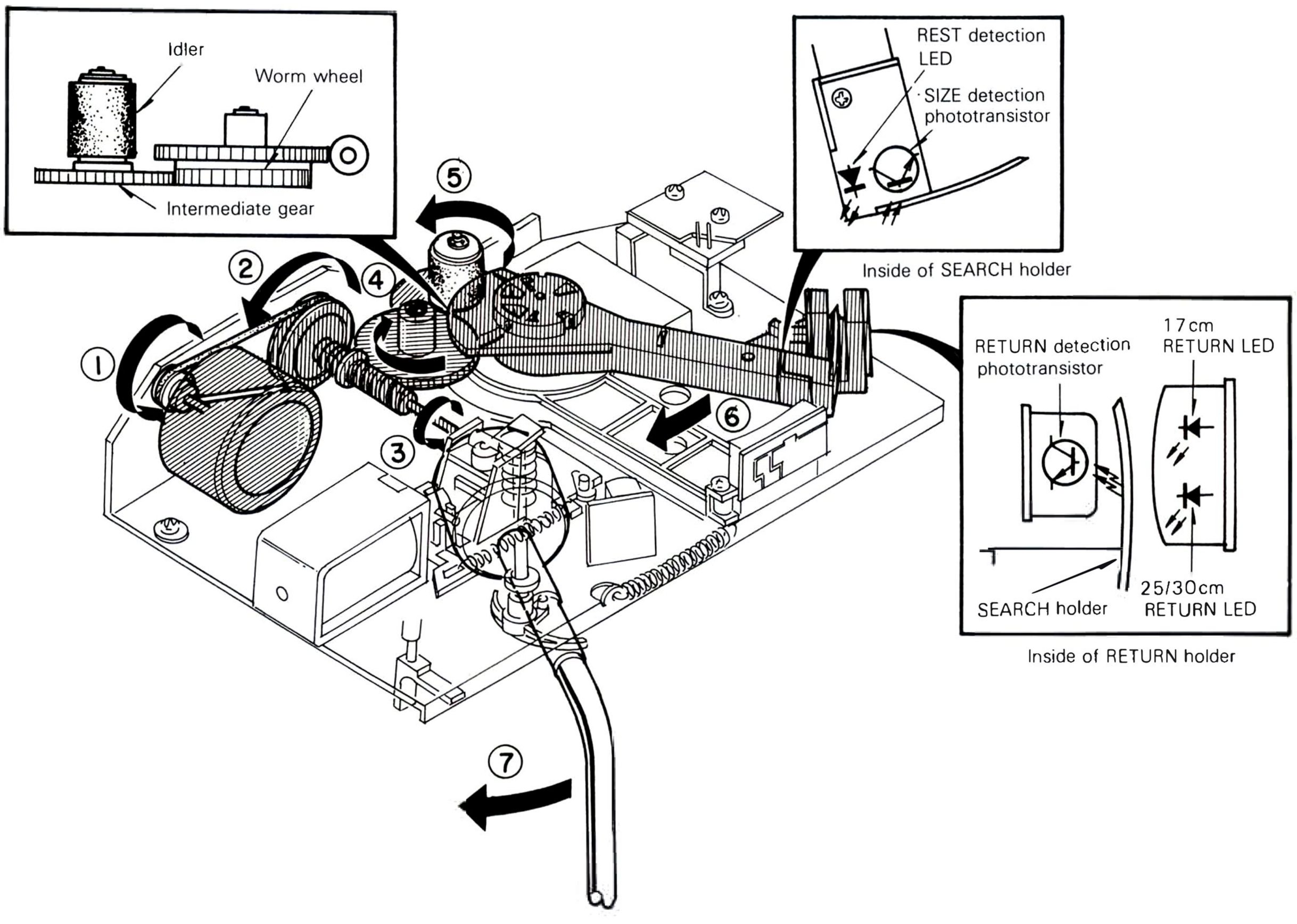


Lead-out detection

OPERATION OF MECHANISM

RETURN Operation

When the lead-out operation is completed, the DC motor rotates in the opposite direction to that in the lead-in operation. When the search arm comes to the start point, the REST detection phototransistor is turned ON, so that the solenoid is turned OFF and the DC motor stops.



RETURN operation

OPERATION OF MECHANISM

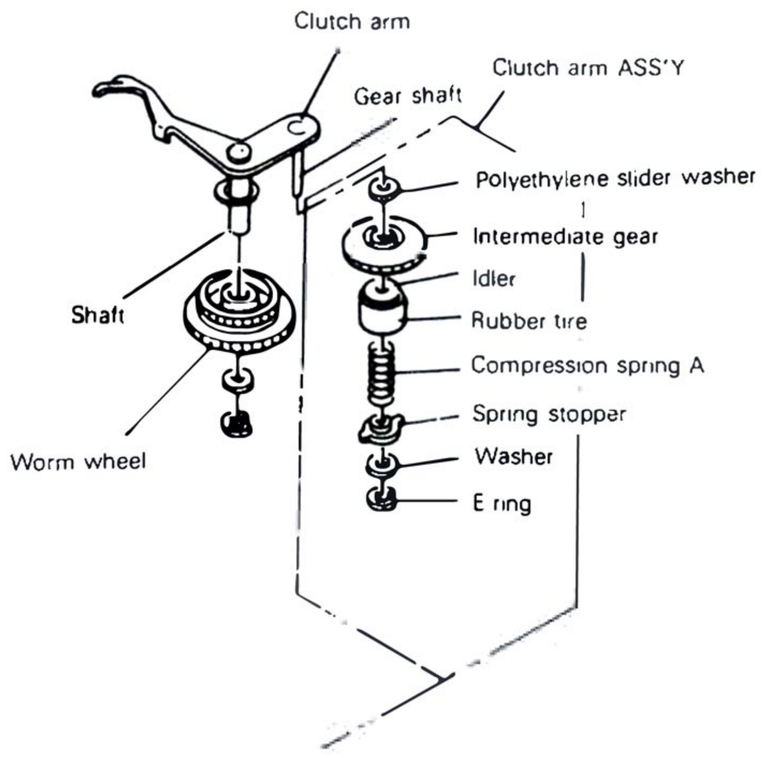
REPEAT Operation

While the search arm is moving toward the arm rest after a record is complete, it passes the POSITION holder. At this time, if the REPEAT condition has been set, the LED of the POSITION holder is lit. The SIZE detection phototransistor receives light from the LED. Therefore, the RETURN operation is stopped and PLAY restarts. The above operation is repeated until the REPEAT condition is reset.

Slip Mechanism

In ordinary automatic mechanisms, if the tonearm is forcibly stopped during operation, the mechanism may be damaged.

In the KD-4100, a slip mechanism is employed to decrease the load on the mechanism. In this slip mechanism, the torque of the intermediate gear is transferred to the idler by means of the compression of a spring. If the tonearm is forcibly stopped during operation, the intermediate gear in the clutch arm ASS'Y races so that no rotation torque is transferred to the idler. This is because the polyethylene slider washer slips.



Clutch arm slip mechanism

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