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Researching Electronic System of the SC-920 Control Circuit of the DDL-8700-7 Single Needle Sewing Machine and Application

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Abstract

The DDL-8700-7 is a single-needle electronic sewing machine that uses a servo motor to drive the main shaft. This sewing machine has advantages such as being noiseless, energy saving, automatic thread trimming, reverse feed, wiper, and lifting of the needle bar to the highest position when the machine stops... The paper presents the research results of the relationship between the mechanical, electrical, and electronic parts of the SC-920 control circuit in the DDL-8700-7 single-needle sewing machine; analyzing the operating principle of the SC-920 control circuit electronic system according to each control block. In this study, theoretical and experimental research methods were used to measure, test, and evaluate the parameters. The obtained theoretical and experimental research results contribute to building a theoretical scientific basis for making test methods and repairing circuits for some electrical and electronic errors in the error code list of SC-920, helping the repairer identify defects for repair and replacement

Keywords: The SC-920 control circuit, the DDL-8700-7 single needle sewing machine, errors.

1. Overview

In the electronic sewing machines of JUKI, the SC-920 control circuit plays an important role in controlling a number of sewing devices such as 1-needle lockstitch machine; 2-needle, lockstitch machine; 1-needle, lockstitch, Zigzag stitching machine. Types of electronic sewing devices with control circuit SC-920 are commonly used in sewing companies due to the advantages of a new generation of machines, reduced noise, energy saving by using servo motor to control speed of main shaft [1-3]. When the power switch is turned on for sewing machines using servo motors, the motor will not work, only when the operator presses the accelerator pedal will the servo motor work to control the spindle speed.

SC-920 controller circuit is a new type control circuit with energy saving properties. The control box is resistant to voltage fluctuations, noise and vibration. The circuit is designed with a mode to reduce power consumption by up to 25% during idle time when the motor is not spinning (compared to SC-910N) [4]. The servo motor has a closed control loop, is a three-phase motor with a working frequency of up to 15 kHz, so the motor speed can vary from 0 rpm to 5000 rpm [5]. The servo motor transmits motion to the main shaft through a belt and flywheel. So the spindle speed is the same as the speed of the servo motor. Electronic single-needle electronic sewing machine using servo motor has many control circuits such as SC-550, SC-910N, SC-920C, in which SC-920C circuit is the most energy efficient. The SC-920 circuit is a control circuit for operating programs of some electronic sewing devices, which can work with control panels such as CP-18, CP-180, IP-110F [6]. The CP-18 control panel is designed to accommodate a material sensor. The CP-180 control panel has some more display functions than the CP18 panel. The IP-110F console can access data via Compact Flash (CF) digital memory cards.

The SC-920 control circuit is applied to a number of sewing devices such as 1-needle lockstitch machine DDL-5550N-7, DDL-5600N-7, DDL-8700-7, DDL-9000B, DLN-5410N-7, DLU-5490N-7, DLD-5430N-7, DMN-5420N-7, DLM-5400N-7; the LH 3500A double-needle sewing machine is equipped with many new innovative mechanisms such as integral, semi-dry, thread coin and lubricating oil system; electronic zigzag stitching machine LZ-2282N-7, LZ-2284N-7.

Currently, the documents provided by Juki to sewing companies about SC-920 control circuits are mainly manuals for operation and maintenance of mechanical parts for each machine separately in English, without giving any information about the relationship between mechanical, electrical and electronic parts in a single needle sewing machine. As for the control circuit of the SC-920 control circuit, especially the circuit structure, the control board functions, due to the security of the company, have not been transferred.

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The purpose of the author's research is to analyze the electronic system of the SC-920 control circuit to provide a theoretical basis for controlling a single-needle electronic sewing machine, a method of checking and repairing the circuit for some electrical and electronic errors in the SC-920 error panel.

To achieve the research objective, the author performs the following tasks:

- Firstly, studying the theoretical basis of SC-920 controller circuit including concept of SC-920 controller circuit, SC-920 controller circuit specifications, SC-920 controller circuit functions, applying control circuit SC-920 in some electronic sewing devices;

- Secondly, studying and building the relationships between the mechanical, electrical and electronic parts of the SC-920 control circuit in the 1-needle sewing machine DDL-8700-7;

- Thirdly, drawing the electronic system of the SC-920 control circuit according to the module of each block in the 1-needle sewing machine DDL - 8700 - 7;

- Fourthly, analyzing the operating principle of the SC-920 control circuit electronic system according to the module of each block in the 1-needle sewing machine DDL-8700-7;

- Fifthly, giving a method to check and repair the circuit for some electrical and electronic errors in the SC-920 error panel.

2. Objects and Research Methods

2.1. Research Subjects

In this study, the author selected the control circuit SC-920; the relationship between the mechanical, electrical, and electronic parts of the SC-920 control circuit; the SC-920 electronic system control circuit.

2.2. Research Methods

In the theoretical method, the author has studied domestic and foreign documents related to the topic in hard and soft copies. In addition, the author uses the data on the company's official website, forums related to electronic sewing machines in general and electronic single-needle sewing machines in particular. The power supply circuit for the servo motor is simulated on the PSIM software.

In the experimental method, the author studied electrical circuits, measuring, testing and evaluating the parameters of the SC-920 control circuit on the basis of documents supplied with the machine.

Through studying the company's documents and experimental research, the content and drawings are made by the author to model the control process, build control blocks. and detail those blocks. From there, it is possible to clearly understand the control process, operating principles and provide scientific bases to identify and repair SC-920 control circuit errors in a single-needle electronic sewing machine.

3. Analysis of the Operating Principle of the SC-920 Control Circuit Electronic System according to the Module of Each Block

The author has introduced the SC-920 control circuit electronic system according to the module of each block, this is the basis for researching newer electronic machines.

3.1. Electronic Block Diagram by Module

When supplying power to the motor, the speed of the motor through the belt transmits motion to the main shaft. When the spindle moves, the actuators of the sewing machine are affected. The relationship between mechanical actuators and electrical and electronic circuits is analyzed as follows [7].

The input signal of automatic reverse feed components can be re-stitching from the control panel, re-stitch switch or back-stitching hand. When there is a command to control the reverse feed solenoid, it will be sucked towards the magnetic pole of the solenoid, pulling the automatic reverse feed mechanism to help the machine reset the nose automatically according to the installed program (Fig. 1).

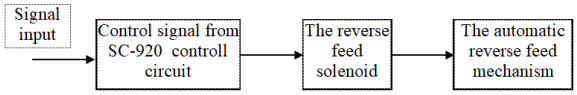

Fig. 1. Block diagram of automatic reverse feed mechanism

The input signal of automatic thread trimmer components is set to thread trimming from the control panel. When there is a thread trimming control command, the solenoid is energized and pulled by the mechanical thread trimming mechanism to help the machine cut the sewing thread at the end of the sewing process automatically (Fig. 2).

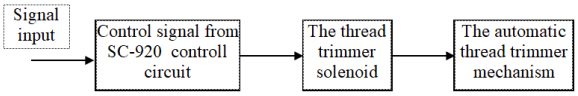

Fig. 2. Block diagram of automatic thread trimming mechanism

In the automatic wiper component, when the thread take-up control command is set, the electromagnet is energized and the mechanical thread take-up mechanism pulls the machine to automatically release the thread at the end of the sewing process. Switch that allows power to the wiper solenoid (Fig. 3).

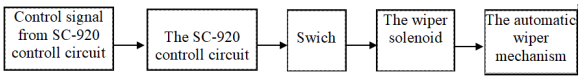

Fig. 3. Block diagram of automatic wiper mechanism

In the main shaft pulley mechanism, the sewing machine has an automatic needle bar detection system, turning on the needle bar machine will automatically rotate to the highest point, then the speed sensor will determine the needle position in combination with the magnet system on the pulley that will make the spindle pulley bring the needle bar to the highest position (Fig. 4).

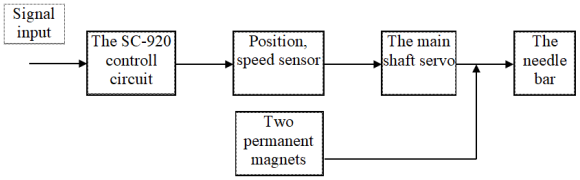

Fig. 4. Block diagram for automatic lifting of the needle bar to the highest position

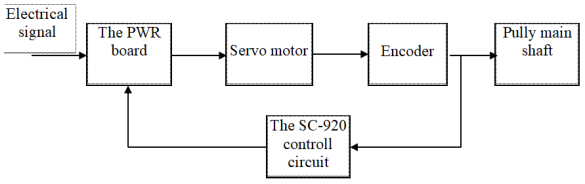

Fig. 5. Servo motor control block diagram

When the power switch is on, the operator will press the accelerator, the current driving the IGBTs in the PWR circuit will change the motor speed. When the motor rotates, the encoder will transmit the torque (current), speed and position pulses, transfer these signals to the SC-920 to control the servo motor in a closed loop to stabilize the servo motor's operation (Fig. 5).

3.2. Electronic System Control Circuit SC-920 according to the Module of Each Block

3.2.1. Power supply block

Power supply block of the PWR circuit. Single-phase AC 220V power is supplied to the PWR circuit through CN1 (Fig. 6) [8].

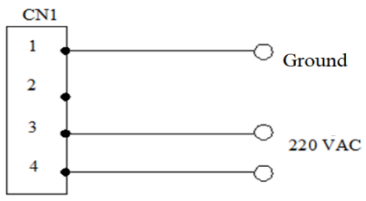

Fig. 6. Diagram of 220VAC power supply to the PWR circuit

Power supply for servo motor and current feedback signal simulated by PSIM software (Fig. 7), in which 1-phase bridge rectifier provides DC power, inverter converts DC power to 3-phase AC power supply for servo motor (Fig. 8).

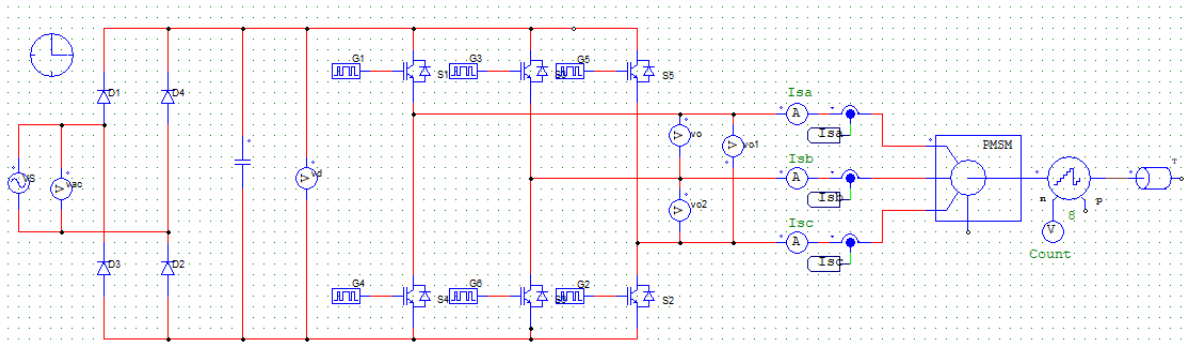

Fig. 7. Power supply for servo motor

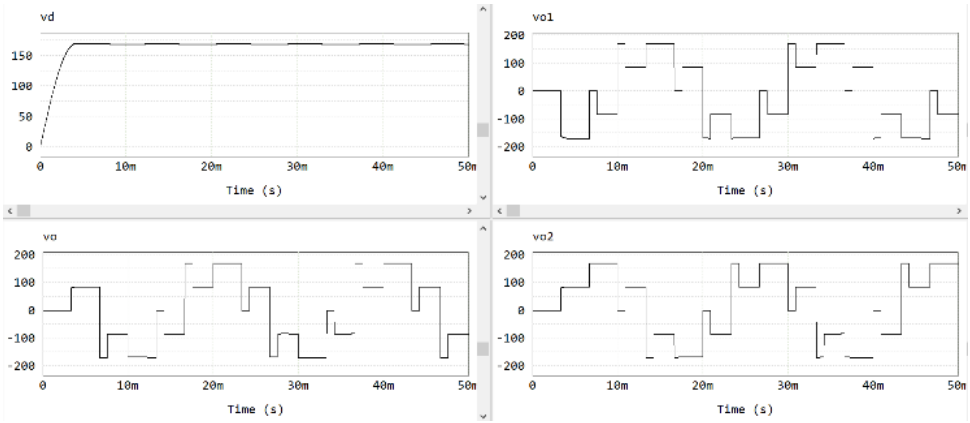

Fig. 8. Diagram of DC voltage and 3-phase AC voltage waveform

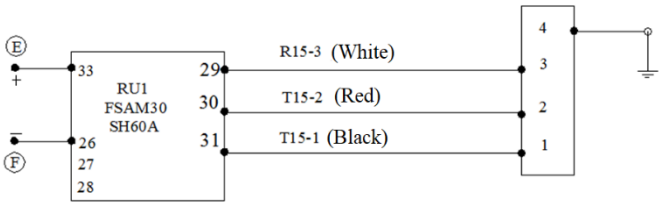

Fig. 9. Diagram of three-phase AC power supply to servo motor

Circuit diagram of three-phase AC power supply for servo motor through RU1 FSAM30SH60A. RU1 FSAM30SH60A functions as a three-phase bridge inverter using IGBT to convert direct voltage to three-phase voltage with the highest level of 600VDC-30A, switching frequency 15kHz. The servo motor has the following parameters: AC servo motor M92, power consumption 450W, speed 5000 rpm, voltage 280 - 340VDC, 3A current, 3 phase (Fig. 9)

The power supply circuit for LED1 indicates that the PWR circuit is active (Fig. 10). Capacitor C49, C58 has a DC power filter function. Resistors R87, R88 create a voltage divider that provides voltage for LED1 (UAK of LED1 = 3VDC)

At pins 10, 11 of transformer T1 there is a secondary signal, voltage (+) through DA5. The output voltage of pin 1 of CN13 is +33V. The voltage through U8 to pin 3 of CN13 is 24V (Fig. 11). Capacitors C62, C63 have overvoltage protection function. RU5 PQ05RH11 has an output voltage of pin 2 of +12V going to pins 1, 2, 3 of CN14 (Fig. 12).

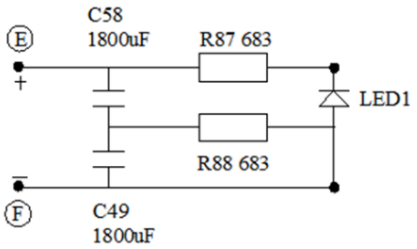

Fig. 10. Power supply circuit diagram for LED1

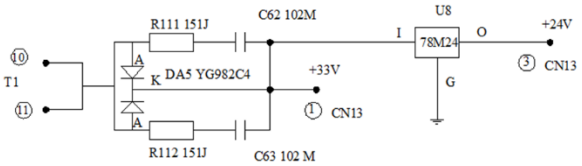

Fig. 11. +24V, +33V power diagram for SC-920 controller circuit

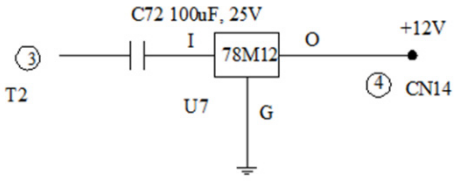

Fig. 12. +12V power diagram for SC-920 controller

3.2.2. Power supply block of the SC-920 circuit

Power +24V, +33V at the CN35 pin of the SC-920 circuit is received from the CN13 pin of the PWR circuit (Fig. 13). Source +5V, +12V at CN31 pin of SC-920 circuit are received from CN14, CN15 of PWR circuit (Fig. 14).

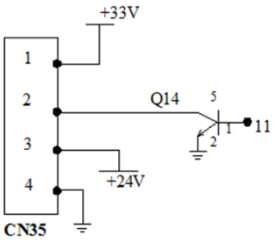

Fig. 13. +24V, +33V source diagram of the SC-920 controller circuit

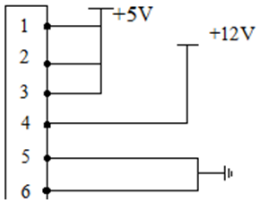

Fig. 14. +5V, +12V power diagram of the SC-920 controller circuit

3.3. Protection Circuit Block

3.3.1. Protection circuit block for power circuit PWR

Fuses F1, F2 protect the short circuit from the power supply to the PWR. ZRN1, ZRN2, ZRN3 temperature stabilizer for PWR circuit. The ANR provides external overvoltage protection for the PWR power circuit (Fig. 15). Q8 is short-circuit protected by the F4 250V T3.15A fuse (Figure 16).

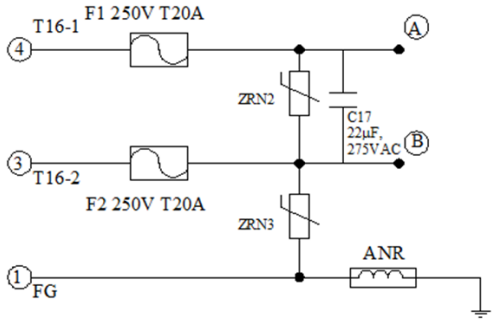

Fig. 15. Circuit diagram of short circuit protection from AC power for PWR power circuit

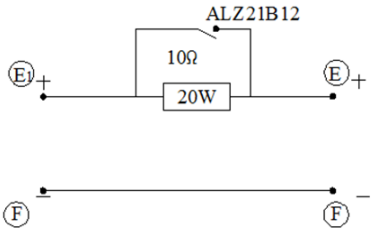

Fig. 16. Short circuit protection circuit diagram for Q8 2SK3550 [author source]

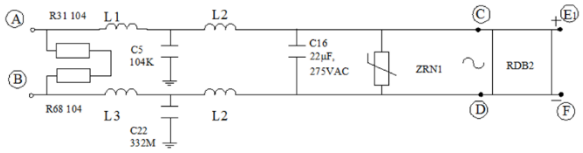

Fig. 17. Circuit diagram of external overvoltage protection for PWR power circuit

Capacitor C5, C22 with surge protection (Varistor or Metal Varistor Oxide (MOV)) is a special resistor used to protect electrical circuits against short-duration high voltage surges. High voltage spikes and spikes will attack power lines and will destroy the power supply of devices. At that time, the lightning capacitor installed in the circuit will be able to prevent these high voltage spikes and spikes, preventing them from damaging the device. Surge capacitors are also known as voltage dependent resistors (VDR) (Fig. 17). Capacitors C16, C17 play a major role in noise reduction.

The current after passing through the RDB2 bridge rectifier is an impulse direct current. This surge current can damage the inverter IC RU1 FSAM30SH60A. So to prevent the inverter IC RU1 FSAM30SH60A from being damaged by the surge current, a 10Ω 20W R86 power resistor is introduced in the series circuit to block the surge current for a short time after the power is turned on.

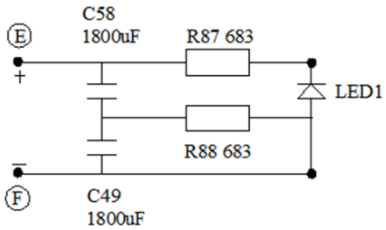

Fig. 18. Jump current limiting circuit diagram using ALZ21B12 Series Relay

Due to this purpose operation, the resistor is short-circuited across its two terminals to create a strong bypass resistor. This circuit is called an impulse current limiting circuit. The relay has parameters Ucd = 12VDC, class B insulation, maximum cutting current 16A, maximum cutting voltage 440 VAC (Fig. 18). The isolation circuit between the dynamic part and the control part via photocoupler PH7 PC3H3J00000F avoids interference from the dynamic circuit to the control circuit (through the CN14, and CN15 pins) (Fig. 19).

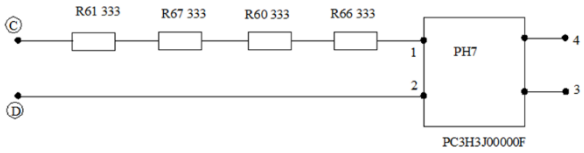

Fig. 19. PH7 isolation circuit diagram between the driving part and the control part to pins CN14, CN15

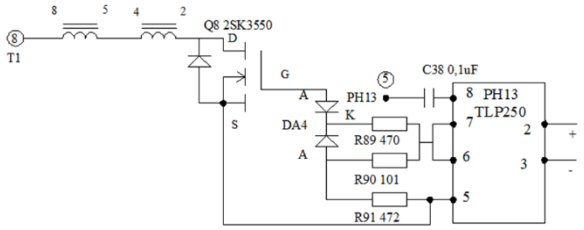

Fig. 20. PH13 isolation circuit diagram between the driving part and the control (through to the CN13 pin)

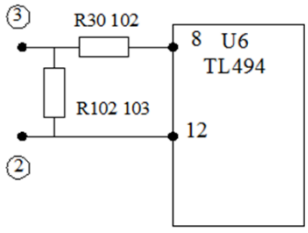

Fig. 21. PH13 TLP250 control signal supply pinout

The isolation circuit between the driving part and the control part through the PH13 TLP250 photocoupler avoids interference from the dynamic circuit to the control circuit to the CN13 pin (Fig. 20). The PH13 TLP250 control signal is taken from the pulse width control circuit TL494 to pins 2 and 3 of the PH13 TLP250. The transformer is fed a signal to the primary coil by opening or closing Q8 (Fig. 21). The CN11 connector is connected to the M6008-350-AAL resistor to identify the type of locomotive.

3.3.2. Protection circuit block for SC-920 controll circuit

The SC-920 circuit is short-circuited by the F1 250 V T 6.3 A fuse. The control signal from pin 3 of U6 through Q12 amplifies the open control signal Q23, leading the feedback signal to CN37 (Fig. 22). The thermostats ZNR 1, 2, 3, 4 have temperature stabilization function for the SC-920 circuit. Since the Q25 mosfets switch the thread trimming solenoid, Q23, Q24 control the reverse feed solenoid, Q22 switches the wiper solenoid, so it is necessary to have thermostats for the SC-920 circuit to work stably (Fig. 23).

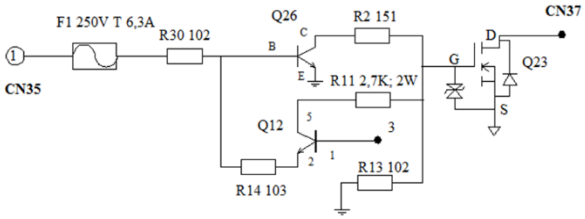

Fig. 22. SC-920 short circuit protection circuit diagram

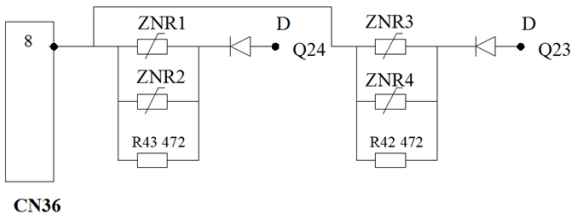

Fig. 23. SC-920 thermostat circuit diagram

3.4. Electronic System Block Controls Devices Connected to the SC-920 Circuit

The SC-920 circuit is controlled by the U6 64F2398F20. The signals about the position, direction of rotation, and speed of the servo motor are transferred to U6 through the encoder encoder at pin CN30. The physical signals are converted to pulses through the U3 TC74HC7244A stabilizer voltage form and generate pulses sent to U6. U11 has the same function as U3 (Fig. 24).

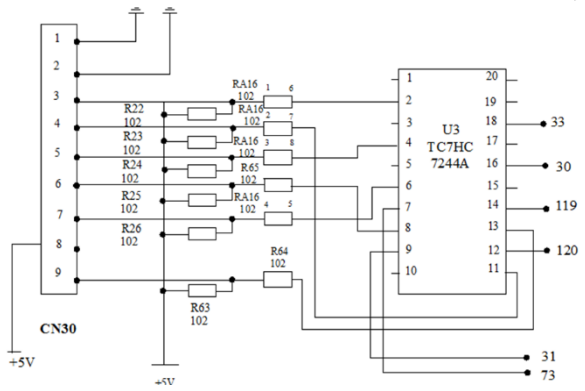

Fig. 24. Circuit diagram for receiving signal from voltage stabilizer Encoder and sending pulse to U6

The control signal of the PWR circuit through CN14, CN15 is connected to CN31 and sent to U6 through U11 TC74HC7244A stabilizes voltage and generates pulses sent to U6. Serial U7 buffers receive signals from CN31 to U6, 64K memory capacity (Fig. 25).

The sensor signals about position, speed, and direction of rotation at the machine head are transferred to U6 via CN33. Those signals are converted to pulses through U1 7W14 (Fig. 26).

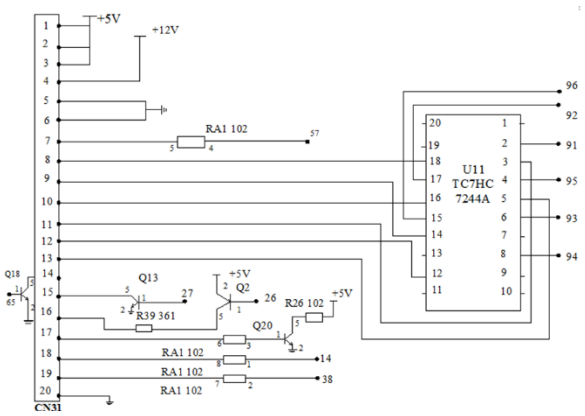

Fig. 25. Circuit diagram for receiving auxiliary power signal from PWR to U6 circuit of SC-920 circuit

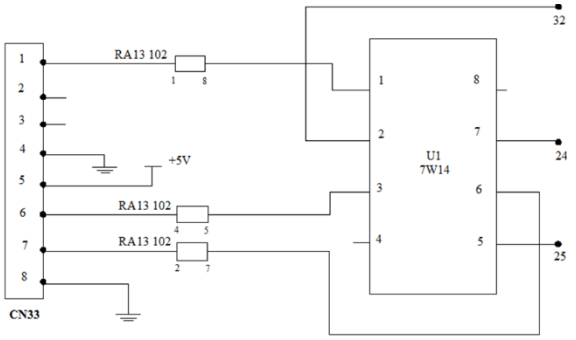

Fig. 26. Circuit diagram of signal synchronization from the sewing machine head

The accelerator pedal signal is converted into an electrical signal through the accelerator sensor. The current signal from the throttle rheostat passes through U8 LM358, which has the function of amplifying and generating square pulses at the output of U8. This signal is transferred from pin 7 of U8 to pin 74 of U6. The pedal sensor is only used for the SC-921 control circuit to automatically return the pedal to the stop position (Fig. 27).

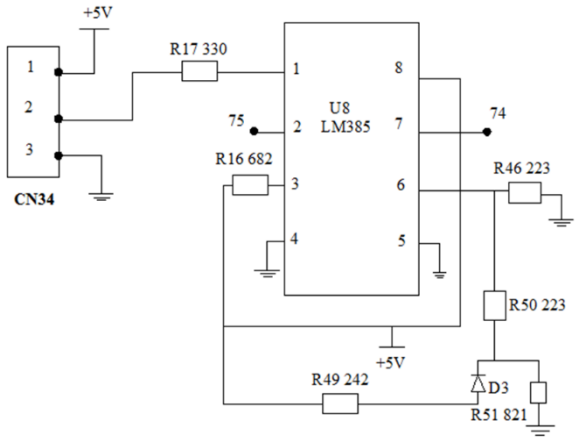

Fig. 27. Circuit diagram of the signal from the pedal sensor to U6

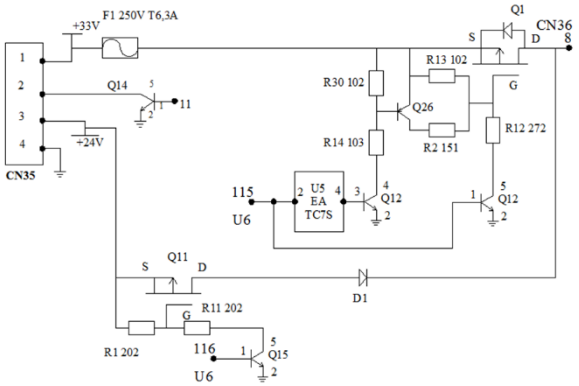

Fig. 28. Circuit diagram of power supply for automatic presser foot lifting solenoid

The +24V, +33V DC supplies from the PWR circuit from the CN13 are routed to the SC-920 circuit via the CN35 (Fig. 28). +33V power is supplied to the automatic presser foot lifting solenoid. Q1 has the function of opening and closing the source +33V, Q12 controls the opening of Q1. If using compressed air to open and close the solenoid, the supply is +24V. Q11 has the function of opening and closing +24V source, Q15 controls the opening of Q11. The CN36 jack connects to the solenoid. Mosfet Q11 opens and closes the +24V source for the solenoid. Pins 1 and 8 are connected to the thread trimming solenoid. They only have a resistance of about 7.5Ω, the thread trimming solenoid is closed or opened through the Q21 mosfet. The control current from U6 through transistor Q17 opens and closes mosfet Q21 (Fig. 29).

Pins 6 and 13 are connected to the reverse feed solenoid. They have a resistance of about 6.5Ω, the solenoid is closed or opened through the Q23 mosfet. The control current from U6 through transistor Q15 opens and closes mosfet Q23. Pins 2 and 9 are connected to the wiper solenoid. They only have a resistance of about 8.5Ω, the solenoid is closed or opened through the Q22 mosfet. The control current from U6 through transistor Q6 opens and closes mosfet Q22. Pins 5 and 12 are connect to the reverse feed lock, pins 7 and 14 are connected to the throat thread solenoid (if installed). They are only opened or closed through the Q24 mosfet. The control current from U6 through the transistor Q16 opens and closes the mosfet Q24. In fact, the throat thread solenoid only works to open and close the thread tension disc according to the operating requirements. In automatic mode, stop the machine, the suction coil automatically opens the tension nut, when the machine works, the solenoid automatically closes.

The automatic presser foot lifting solenoid is controlled by Q25, the mosfet Q25 is controlled by transistor Q16 (Fig. 30). Diodes D4, D5, D6, D7, D8 limit backflow to the mosfets Q21, Q22, Q23, Q24, Q25. CN38 is connected to the control panel which can be programed different types of seams, different working modes. The 0Ω resistor acts as a conductor or a fuse against short circuit. Internal converter DC/DC according to RS-232 interface standard. Manual setting signals are converted via U10 D4723GS to U6 (Fig. 31).

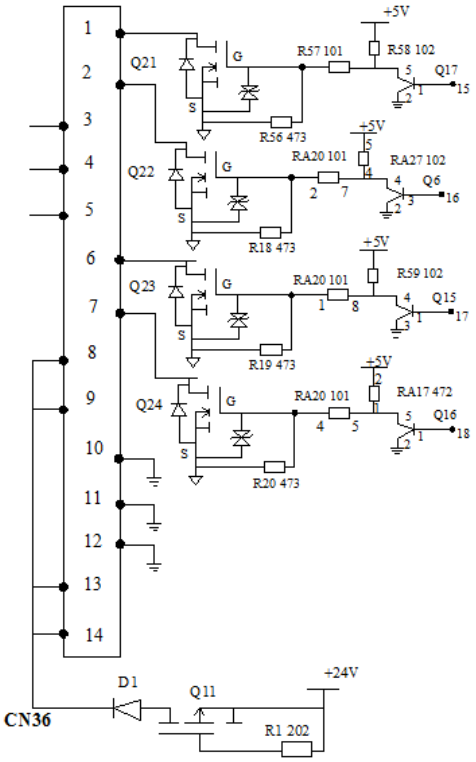

Fig. 29. Circuit diagram to control the opening and closing of solenoids

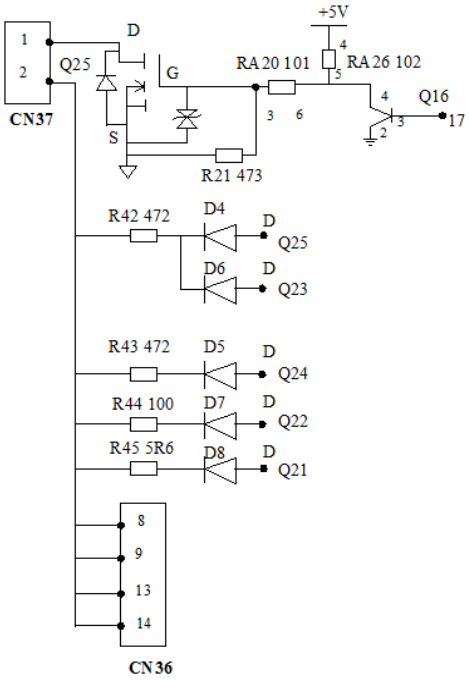

Fig. 30. Circuit diagram to control the opening and closing of automatic presser foot lifting solenoid

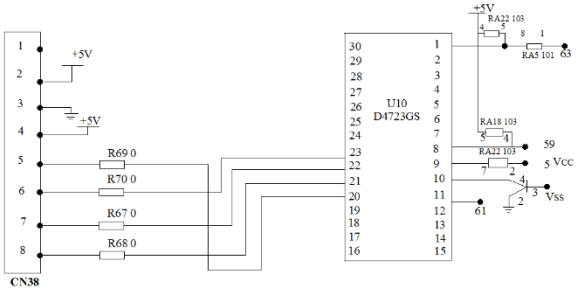

Fig. 31. Circuit diagram for connection to the control board

The pedal sensor is connected at pins 1, 3, 4, the rheostat value is 1kΩ. Pin 1 is provided +5V power, pin 4 is grounded. Pin 3 is connected to the pedal. When the accelerator is pressed, the rheostat output voltage changes between 1V and 2V through resistor R6 to pin 111 of U6. The variable current will be fed to the IC RU1 FSAM30SH60A to control the opening angle of the IGBTs in the inverter, thereby changing the output voltage supplied to the servo motor. When the voltage is adjusted up or down, the motor speed increases or decreases accordingly (Fig. 32).

Pins 5, 6 are connected to the presser foot lifting lock, pins 7, 8 are connected to the thread trimming lock (Fig. 33), pins 9, 10 are connected to the lock in case of high speed motor, pin number 11, 12 connected to the lock in case the motor runs at low speed

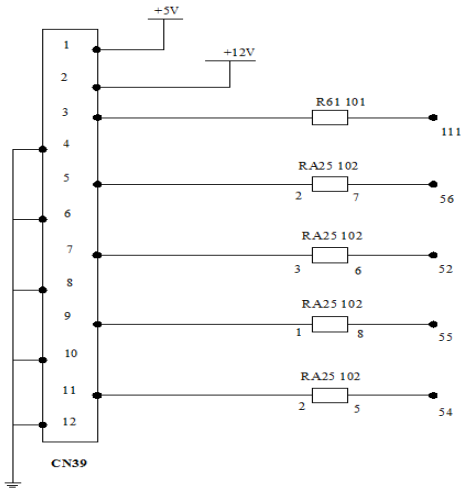

Fig. 32. Pin diagram to the pedal.

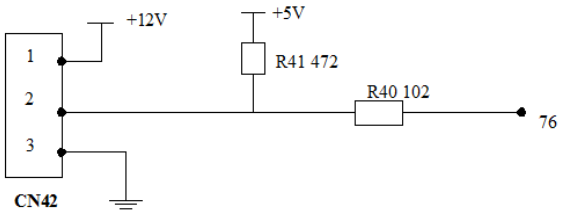

Fig. 33. Pinout for safety thread trimmer switch

When tilting the sewing machine without turning off the power, the safety lock (standard) is opened disconnecting the power supply, the sewing machine will not operate to avoid danger (Fig. 34).The CN50 pin connected to the counter has the input and output signals described in the function table of the CN50 pin connected to the counter (Fig. 35).

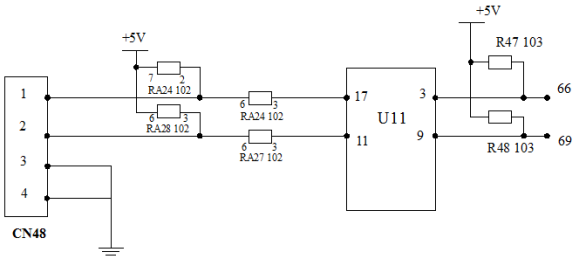

Fig. 34. Pinout for safety key

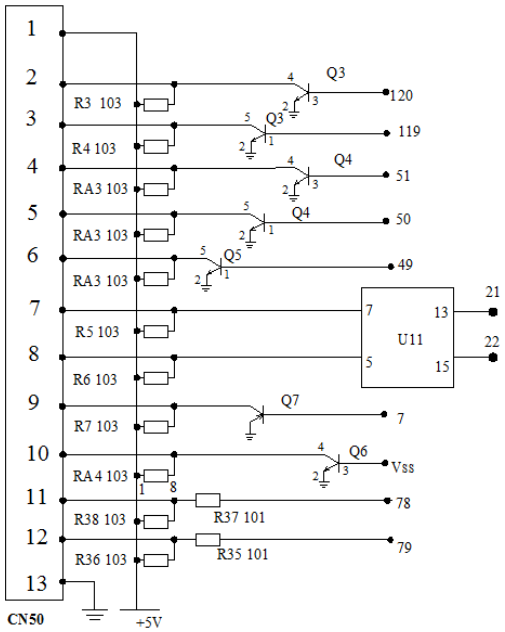

Fig. 35. Pin diagram connecting CN50 to counter

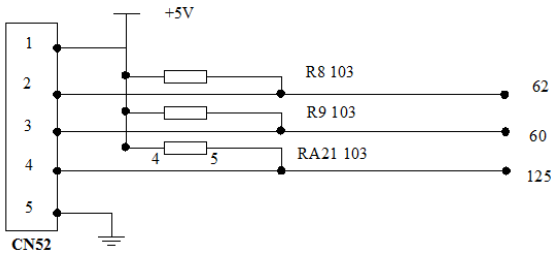

Fig. 36. U6 to CN52 pinout

Pin CN52 is connected to the tagging program of the operation panel IP 110F. The material sensor connected to the CN54 has 4 pins (sealed) (for use with CP18 control board only) (Fig. 36). The power signal through U6 and the 24V signal passed through U2 are dual signal comparators. If power is available to the power supply indicator light, the BZ unit will beep to signal that the electronic circuit is working (Fig. 37). CN 57 is connected to the product counting control part (Fig. 38).

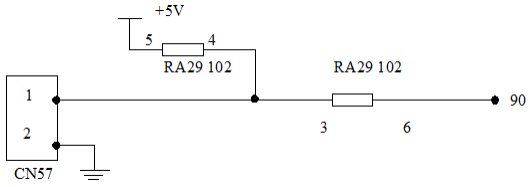

Fig. 37. 24 V external power connector

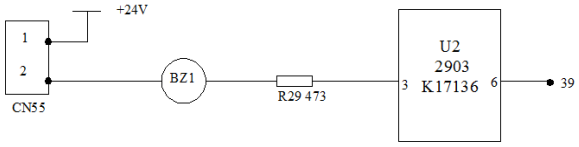

Fig. 38. Pinout of product counting control part

4. Methods of Checking and Repairing Circuits for Some Electrical and Electronic Errors in Error Code List SC920

4.1. Checking the Power Circuit PWR.

Based on the schematic diagram of electronic circuits, the mechanical structures have studied, you should pay attention to the following characteristics before repairing

The control system consists of transformers, AC voltage stabilizers and filter circuits, active components such as algorithmic ICs used for comparing digital ICs used for digital control circuits, the control circuit ensures the symmetry of the alpha control angle for all channels. Therefore, when repairing, do not rotate, twist or adjust to these components. The best way is to clean it, use compressed air to blow all the dirt out of printed circuits and components. Using a hair dryer to blow hot air less than 80 degrees Celsius into the places where moisture is suspected. Tighten the screws at the junction, press firmly on the jacks, if necessary, re-solder damaged or broken component pins. In many cases, just a simple repair like the above will make the machine work well again.

Power block is the most damaged in electronic circuit. Active electronic component ICs are very sensitive to environmental fluctuations such as: fluctuations in the power grid, dusty, humid environments, erratic power grid ups and downs, high temperatures, air with chemical vapors or near the sea. These conditions easily damage the electronic components inside. Observe for any lines on the printed circuit board that are flaking, blistering, or burned. Turning off the power, touch every mosfet, every transistor, every diode, if one component gets hotter than all the others, that's where the problem occurs. Using a soldering iron to remove the suspected damaged component from the printed circuit to check it with a VOM or DMM multimeter, if it is damaged, replace the component with the same code as the symbol. If all is well, try plugging in the sewing machine to work again. Measuring voltage values at reference points such as input source, DC voltage and compare with similar sewing machines.

In case of plugging in the power, turning on the switch to work but the motor does not runt, the power indicator light does not light up. Measuring the output voltage at 3 phases U, V, W equal to 0 but the supply voltage of 220VAC is still enough, it is certain that the problem is in the PWR power block.

Check that the 4 fuses in the PWR circuit are not blown, the voltage after the transformer is still showing that the RDB2 rectifier bridge is damaged, the diode is punctured or the filter resistor is broken. If the fuse always blows, it could be due to the following errors:

- Fuses F1, F2 250V, T 20A are broken, possibly because the line is grounded; noise filter capacitors C16, C17, overvoltage capacitor C5, C22 short, coil L1, L2, L3, short circuit; the temperature stabilizers ZNR1, ZNR2, ZNR3 are shorted. Overvoltage protection device ANR1 is broken.

- The broken F3 250V, T 10A fuse may be due to a damaged T2 transformer; cool touch line; filter capacitor C73, C74 short, primary or secondary winding T2 short circuit; the 1-way filter capacitors C47, C51, C54, C55, C56, C57 leak, short; IC voltage regulator U4 7805, U7 78M12, RU5 PQ05RH11 exploded; damaged rectifier diodes D5, D6, D7, D8; the ZNR4, ZNR5 temperature stabilizers are shorted

- F4 250V, T 3.15A fuse is broken, possibly due to a damaged T1 transformer; cool touch line; High-voltage capacitors C33, C25, filter capacitors C49, C58 are shorted, diode rectifier bridge RDB2 short circuit; the primary or secondary winding T1 is short-circuited; overvoltage capacitors C62, C63, 1-way filter capacitor C69, C84 leak, short; IC voltage stabilizer 78M24 exploded; the rectifier diodes DA4, DA5 are damaged.

Finally, check the resistors, paper capacitors, ceramic capacitors. Particularly, transistors and especially ICs are rarely damaged and if damaged, it is often difficult to detect. If the power block is still good, the signal light is still on but the motor does not run or works incorrectly, damage usually occurs in the inverter block or the signal from the encoder. Check the pedal rheostat (to adjust the DC voltage into the circuit) is damaged or worn, check RU1 FSAM30SH60A at the servo motor power supply pins.

4.2. Checking the CTL SC-920 Controll Circuit

If the servo motor does not run or the control is incorrect from the encoder signal, the solenoids do not work, perform a check of the CTL SC-920 control circuit. Checking LD1 if the light is green, the circuit is normal, if it is red, the circuit is having a problem. Similarly, see if there are any lines on the printed

circuit board that are peeling, oozing or burning. Turning off the power, touch every mosfet, every transistor, every diode, if one component gets hotter than all the others, that's where the problem occurs.

If the fuse F1 250V, T 6.3A is broken, it may be caused by the short circuit of the temperature stabilizers ZNR1, ZNR2, ZNR3, ZNR4; Filter capacitors C12, C13, C14, C4, C6, C8 are shorted, mosfet Q1, Q11 is burnt out, diodes D4, D5, D6, D7 are burned. Checking CN31, CN35 for broken or loose jack to measure supply voltage value +5V, +12V, +24V, +33V. At CN31 measure the supply voltage value +5V, +12V, measure and check whether Q2, Q13, Q20, U3 TC74HC7244A is burnt. At CN35, measure the supply voltage value +24V, +33V and fuse F1 250V, T 6.3A is broken or not. If the servo motor is not running or the control is incorrect from the encoder signal, check CN30 (U3 TC74HC7244A), CN33 (U1 7W14) check the locomotive synchronous signal, CN50 (Q3, Q4, Q5, Q6, Q7, U11 TC74HC7244A), check engine signal counter, CN39 pedal sensor is damaged or worn.

If the solenoids do not work, check the Q11 mosfet to open and close the +24V supply for the solenoid. If the thread trimmer solenoid is not working check mosfet Q21 and transistor Q17. Pins 6, 13 are connected to the reverse feed solenoid. If it does not work, we would check mosfet Q23 and transistor Q15. The wiper solenoid just doesn't work, check mosfet Q22 and transistor Q6. Thread throad solenoid (if installed) does not work, check mosfet Q24 and transistor Q16. Q25 has the function to control the opening / closing of the automatic presser foot lifting solenoid not working, check mosfet Q25 and transistor Q16.

In case of solenoids are broken, it is possible to measure and check the solenoid, replace the solenoid. The control board has no signal, check CN38, U10 D4723GS or use another panel to compare. IP 110F control panel use case, if the card is not received, check CN52. If there is power to the power supply indicator light, the device BZ1 does not beep to signal that the electronic circuit is working, check BZ1, U2 K171A. When tilting the sewing machine without turning off the power, the sewing machine still performs thread trimming, check CN48, U11.

6. Conclusion

The diagrams and methods in the research have been applied in practice, specifically in the teaching of the University program majoring in Mechanical Engineering Technology, Electrical Engineering Technology, the M&E room of the Manufacturing Service Center at Hanoi Industrial Textile Garment University, helping students and technicians understand the overall control process, structure and control principles of each mechanical mechanism in sewing equipment, identify and repair SC-920 control circuit errors in a single-needle electronic sewing machine in detail.

On the basis of an overview study of the JUKI electronic single-needle sewing machine SC-920 circuit on mechanical, electrical, and electronic systems, the author has given the theoretical basis for controlling a single-needle electronic sewing machine, the method to check and repair the circuit for some electrical and electronic errors in the SC-920 errors table.

In this study, the author has added in-depth research papers on electricity, electronics and control in electronic single-needle machines that the company has not provided. JUKI electronic single-needle sewing machine SC-920 circuit is a type of electronic machine with many outstanding advantages. When studying this machine will help students and technicians to design and improve the control process of similar mechanical mechanisms based on the existing design of SC-920 in more advanced electronic machines such as electronic single-needle sewing machines with internet connection, bartacking machines, lockstitch buttonholing machines, eyelet buttonholing machines.

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