Design of an Automatic Solder Station

Kansas City Division

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J. D. Stein, Project Leader

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An automatic solder station was designed to permit blind soldering of connectors to specific cables. The solder station consisted of a fixture to hold and position the connectors on the cables and a control panel to program the soldering process. The control panel allows automatic control of the solder sequence.

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SUMMARY

A solder station including a soldering fixture with built-in heaters and a control panel to provide timed heat and cooling to the fixture was designed. The solder station was developed specifically for soldering connectors to specific cables. The fixture holds the cables and provides positioning of the connectors; while the control panel provides a programmable sequence of heat, dwell, and cooling.

This application required soldering of various other devices like transformers or capacitors to flat cables. The solder fixtures previously designed for these operations were modified so that they could be operated by the control panel developed for the solder station.

DISCUSSION

SCOPE AND PURPOSE

Soldering similar coaxial connectors to three different flat cables at the center pin and around the outside of the connector was required. The center pin is not accessible for normal soldering practices. Development of the solder station was initiated to provide equipment and techniques for the blind soldering of the three flat cables to their coaxial connectors. Work on this project was performed during August 1986 through July 1987.

ACTIVITY

Design Philosophy

The connector and cable are joined by re-flowing solder. Each part is pre-tinned before being positioned by the solder fixture. Heaters in the solder fixture are activated and controlled by the control panel. The heaters raise the temperature of the two solder joints until the solder is re-flowed. The connector remains held against the cable by a small air cylinder until a blast of chilled air from a cold air gun reduces the temperature below the solder melting temperature (Figure 1).

Fixture Design

The soldering fixture was designed to position the cable being soldered with two small pins through holes in the cable. The modified connectors were positioned by two sliding devices with fingers to fit into the connector slot. A small air cylinder holds the connector against the cable until the soldering is complete.

A 150-watt cartridge heater is embedded in a heater sleeve, which contacts the underside of the cable. The heater sleeve is isolated from the fixture body by insulating material. A second 150-watt heater is contained in the upper heat sink body, which fits inside the connector when the air cylinder is extended. The upper heater assembly is attached to the air cylinder by insulating material.

The center pin and the outer conductor ring are soldered at the same time. The upper heat sink body is in direct contact with the conductor while the lower heater adds additional heat to the underside of the cable. Thermocouples are cemented into the upper and lower heater bodies so that their temperatures can be regulated by the control panel. Each heater has its own power cord with associated thermocouple plug for connection to the control panel.

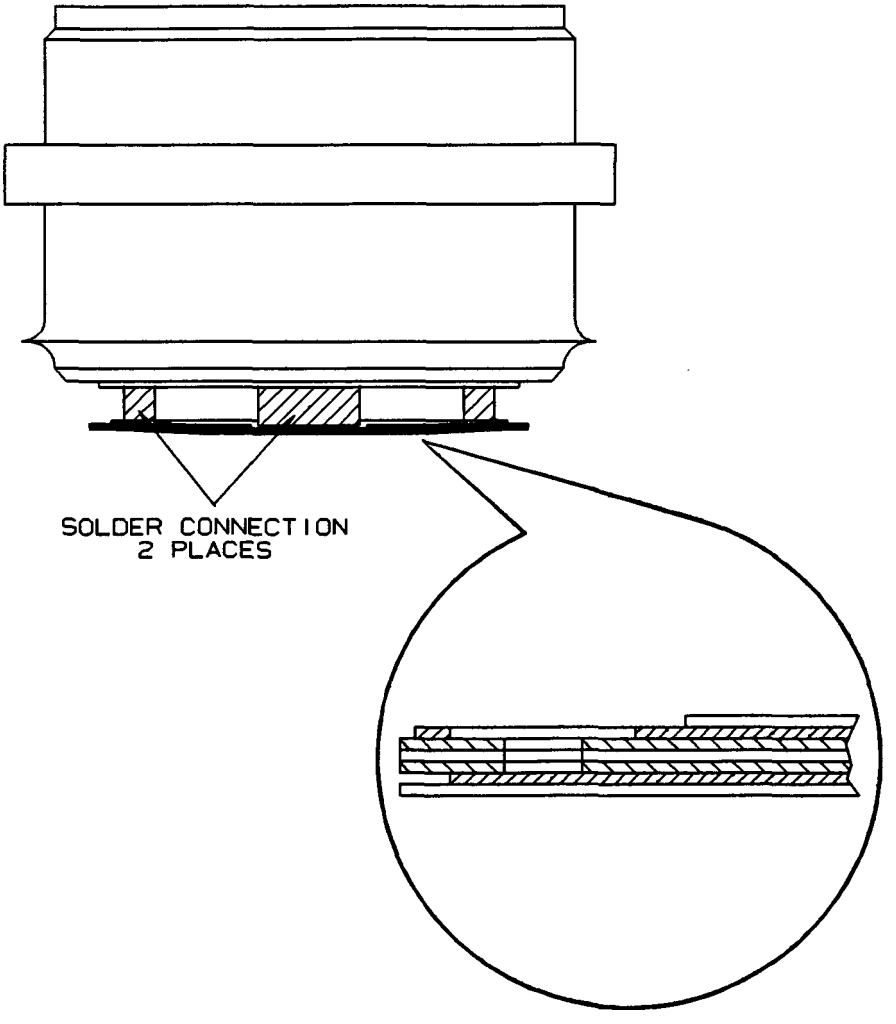

Figure 1. Cross Section of Connector and Cable.

Forced cooling, after soldering, is provided by a small vortex tube which supplies chilled air at 0° to 10°F. The chilled air is aimed directly at the connector and serves to quickly lower the temperatures below the reflow point and to cool the connector body so that it can be easily handled (Figure 2).

Control Panel Design

The control panel was designed specifically to operate the solder fixture. Two channels of regulated heat are available. Temperatures of each channel can be controlled independently by the digital controllers. When the set temperature is reached, the dwell time is activated. Temperature controllers hold the heaters at their set temperatures until the dwell timer expires. Power to the heaters is shut off and the chilled air is turned on when the dwell time expires.

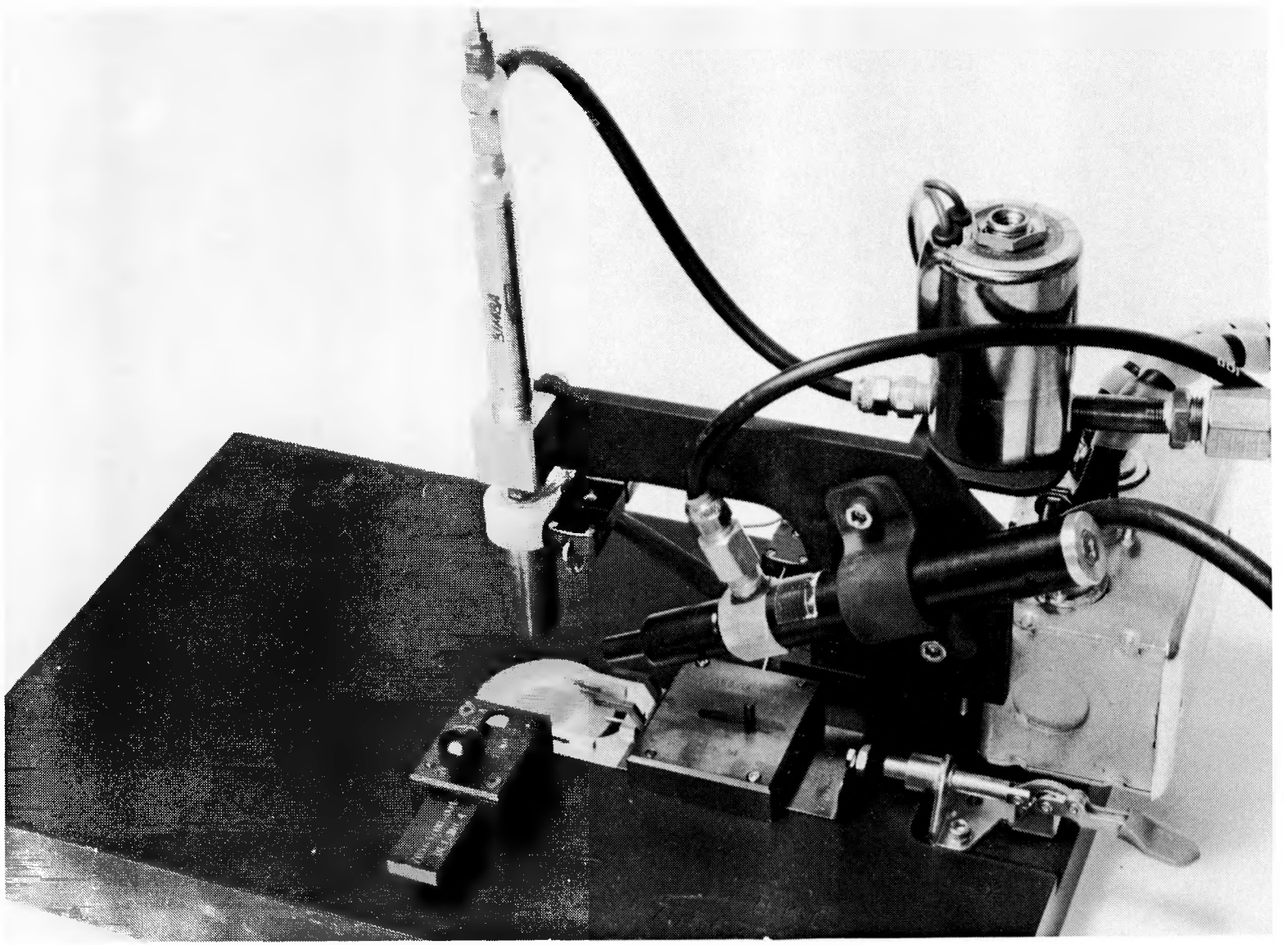

Figure 2. Solder Fixture

The air cylinder that holds the connector against the cable during the soldering is connected to the auxiliary function of the control panel. The air cylinder is activated manually but turned off by the expiration of the time delay of the auxiliary function.

The adjustable feature allows the air cylinder to hold the connector against the cable, after the chilled air comes on, long enough to be sure that the solder joint is chilled. After a few seconds, the air cylinder retracts the upper heater which conserves heat in the upper heater and speeds cooling of the connector body. Chilled air continues to blow directly on the connector body until the cool timer expires. The cycle is complete when the cool timer expires and the part, now cool, can be removed. Total cycle time including heat up, dwell, and cool is approximately 3 min (Figures 3 and 4). This application also required soldering of other devices like transformers or capacitors to flat cables. Solder fixtures to perform the required soldering had already been designed, although without regard to any control system. All of these fixtures used cartridge heaters to provide heat to reflow pre-tinned joints.

As a part of this project, the solder fixtures were modified so that they could be operated by the new control panel. These fixtures were used at the start of production but replaced later by faster commercial resistance-type soldering equipment.

The control panel, however, could be used in applications other than soldering. Any tools or equipment like molds or forming dies requiring one or two channels of controlled heat and chilled air cooling could be automatically cycled by this panel.

ACCOMPLISHMENTS

A self-contained soldering system was successfully developed to permit blind soldering of coaxial connectors to flat cables. A fixture held the cables and provided positioning of connectors; while a control panel provided a programmable sequence of heat, dwell, and cooling.

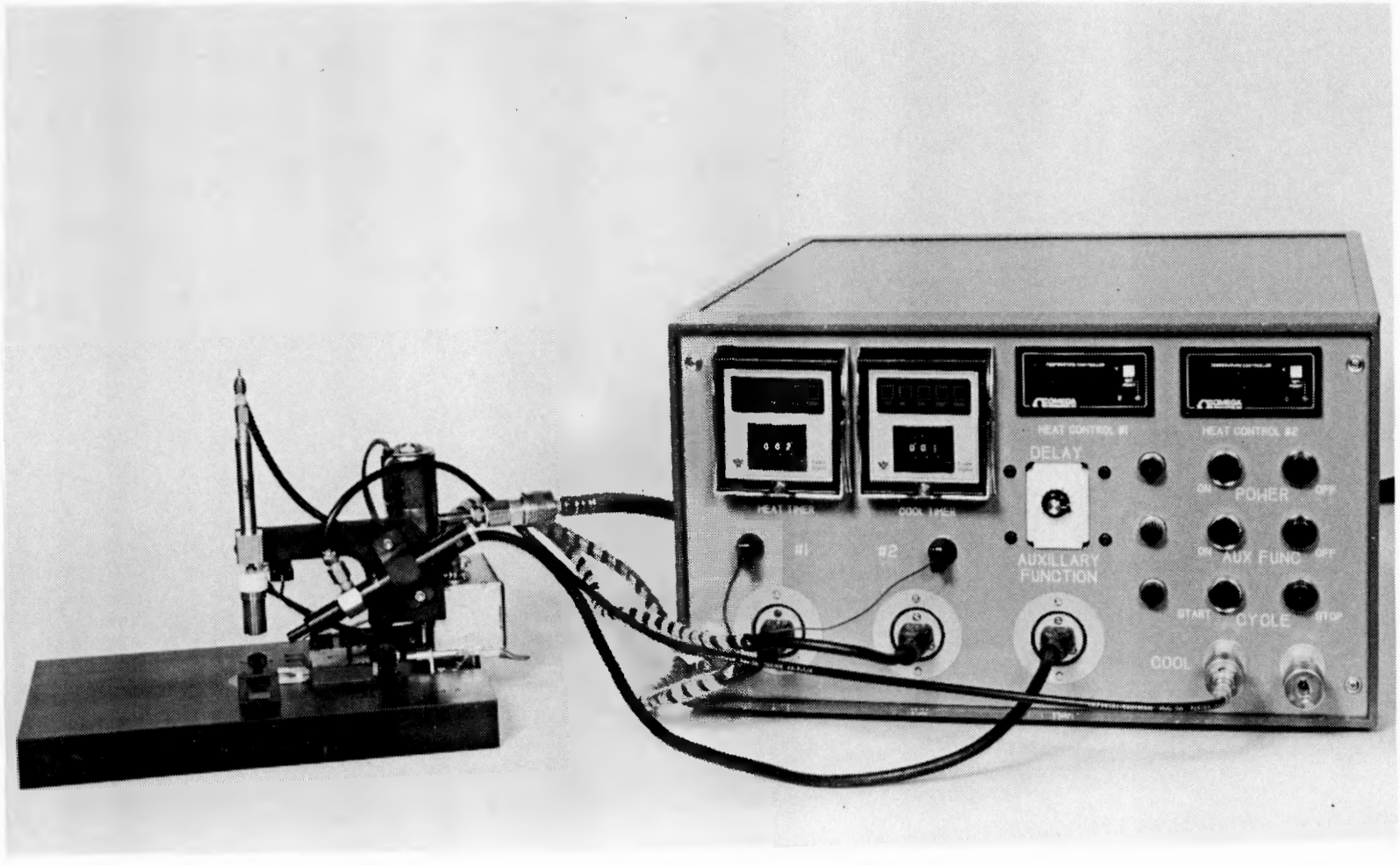

Figure 3. Control Panel With Solder Fixture

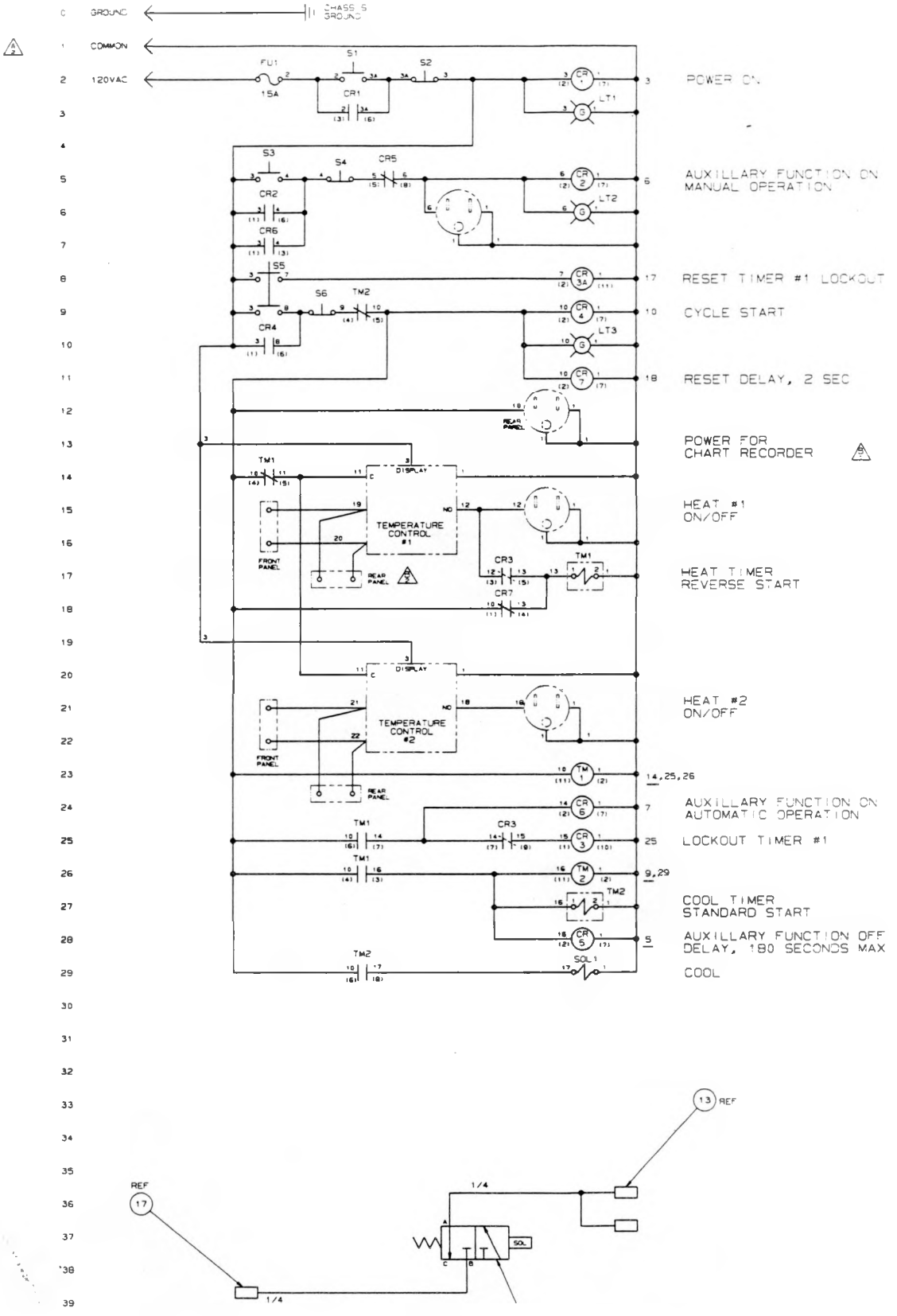

Figure 4. Control Panel Schematic