

CHAPTER 28

Service for Automatic Controls

This section is designed to give dealers, installation and service men practical information on the electrical controls used on an automatic heating system. It deals with complaints and method of tracing, causes of unsatisfactory operation of the heating plant.

It is important to remember that installation or operation of other parts of the heating system can be at fault rather than the controls themselves. A careful systematic check of the entire system is required to determine the actual source of the trouble.

The analysis is divided into sections corresponding to the typical complaints received from customers. There are several possible causes of every complaint, and it is often hard to locate the real trouble.

Controls may be the cause by reason of improper installation, adjustment, or operation, but the whole system should be carefully checked before making any changes or blaming any one part of the equipment.

All complaints on the operation of automatic heating systems can generally be classed under one or more of the headings given in the following *Trouble Shooting Guide*.

TROUBLE-SHOOTING GUIDE

COMMON COMPLAINTS

POSSIBLE CONTROL TROUBLES

NO HEAT.

Procedure:

1. Set Thermostat to call for heat.
2. Press reset button on Stack Switch.
3. If burner does not start, shunt terminals R and W on Stack Switch. Start indicates open Thermostat circuit.
4. If burner does not start, shunt Limit Switch, or
5. Make complete inspection indicated at right.

Stack Switch shuts down on safety.

I. Thermostat (Items A and B)

II. Limit Switch (Items A and B)

III. Stack Switch (Items A, B, and C)

I. Thermostat (Items C, D, E (d and e), H and I)

II. Limit Switch (Item C)

III. Stack Switch (Item C)

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TROUBLE-SHOOTING GUIDE—Continued

Not Enough Heat.

I. Thermostat (Items E (a, b, c), F (a and b), G and I)

II. Limit Switch (Items D and F)

Too Much Heat.

I. Thermostat (Items D, E (d and e), F, G, H, I)

II. Limit Switch (Items E, G, H and I)

III. Stack Switch (Item D)

Domestic Hot Water.

IV. Hot Water Control, or See "No Heat," Items II and III

Flue Gas Odors.

I. Thermostat (Items C and D)

III. Stack Switch (Item C (e and f))

Excessive Fuel Consumption.

V. Fuel Consumption, and See "Not Enough Heat" and "Too Much Heat"

Radio Interference.

VI. Electrical Interference

VIII. All Controls (Item A)

Noise and Vibration.

VIII. All Controls (Item B)

High Electric Cost.

VII. Electric Cost

I. THERMOSTAT

- A. Contacts will not close.
- Base strained or warped*, caused by improper mounting on wall. Remove from wall, straighten if possible and remount, or replace with new thermostat.
 - Bimetal bent* by rough handling. Do not waste time attempting to straighten. Replace with new thermostat.
 - Defective Bimetal*. Replace with new thermostat.
 - Out of calibration*. See G page 274.
 - Mechanism stuck*. Dirt, or cover mounted improperly, causes moving parts to bind. Clean all moving parts carefully. DO NOT USE OIL. Replace cover correctly.
- B. Contacts close normally but no current flows.
- Dirty contacts*. Clean carefully with piece of coarse paper. (Do not use file, sandpaper, or emery cloth.) Blow dust and dirt out of mechanism. Hold contacts firmly together and rub against each other with slight circular motion.
 - Loose wiring connection*. Tighten terminal screws fastening supply wires on back of thermostat. Be sure wire under terminal screw is clean and insulation extends to the screw head.
 - Heater wire burned out or broken*. Inspect for possible short in thermostat circuit. Be sure low voltage thermostat has not been installed on line voltage. (Check name plate on back of thermostat.) Replace with new heater of proper designation.

- Broken wire to thermostat*. Inspect wires from primary control, especially where staples were used to hold wires to joists. Check for moisture or break in insulation. (A small low voltage buzzer is useful for checking thermostat circuits.)
- C. Differential too close. This would cause burner to start and stop so often that the safety heater coil in stack switch would not have time to cool during the "Off" periods. After a few short cycling periods, the safety heater coil would have sufficient heat to trip the bimetal, opening the safety contacts. Short cycling also starts burner before gases are purged from combustion chamber.
- Cycle-ator adjustment set too close*. Turn Cycle-ator pointer a slight distance in the direction of the arrow. This will increase both the burner "On" periods and "Off" periods.
 - Wrong anticipating heater*. Use Type 836-A3 or 860-A3 thermostat. Check thermostat name plate.
- D. Thermostat not rigidly mounted and subject to vibration.
- E. Wrong location.
- Too high from floor*—36 in. maximum recommended.
 - In an air pocket, corner or behind a door*. No circulation.
 - Too close to radiator, large lamp, concealed pipes carrying heat, or where sun strikes most of the day*.
 - In a cool draught from door or window*.
 - On a cold wall, or between heated and unheated parts of the house*.

- F. Differential too wide.
- Cycle-ator turned too far toward "Longer."*
 - Wrong heater wire for circuit.* Check name plate data and current flow.
 - Contact blade sticking to magnet.* Clean all surfaces with coarse paper. Do not use file, sandpaper, or emery cloth. Place paper between contacts. Hold contacts firmly together by hand and pull paper through.
- G. Out of calibration. Check dial setting and thermostat thermometer with an accurate test thermometer. Recalibrate if necessary.
- H. Short circuit in thermostat.
- Bare wires touching at binding screws in back.*
 - Bare pigtail or heater wire touching metal.*
 - Look for moisture, staples driven through, bare spots or broken wires in cable from thermostat to primary control.*
- I. Thermostat set too low or too high, or used as a switch. Instruct customer in proper use of thermostat and danger of discomfort and expense if set back too far or turned off too long. Remind customer that actual temperature at the thermostat may prove to be too warm or too cold for the comfort of persons in the room.

II. LIMIT SWITCH

- A. Contacts not closed—check by shorting across the terminals.

NOTE: All controls equipped with Magneseal contact unit can best be serviced in case of contact failure because of abnormal conditions by installing a new Magneseal. Service men should carry extra Magneseals for this purpose. Return the defective Magneseal to factory for replacement or repair under terms of standard warranty.

- Mechanism jammed* by foreign material, wires, or dirt. Clean mechanism carefully. DO NOT OIL.
- Contacts burned away so they do not touch.* Check system for overload condition. When cause of overload has been eliminated, replace with new Magneseal or new control; the system may require a control with higher electrical capacity.
- Cut-in point of control set too low, or wrong control installed.*
- Steam Limit Control—Bellows stuck* by dirt or water inside. If unable to clean bellows by draining or flushing out, install new bellows or control. Be sure to use pigtail syphon on pressure installations over 15 lbs.
- Steam Limit Control—Bellows cup damaged* or bent from rough handling. Replace with new bellows or control.
- Hot Water Immersion Control.* Power element dead or copper tubing bent too sharply (remote mounting of immersion limit controls) locking charge in either bellows or bulb end of control. Straighten if possible or replace with new power element or new control.

- B. Contacts close but no current flows.
See "Note" under II. A, above.

- a. *Loose terminal connection.* Tighten all binding screws, make sure that wire under screw is clean and bare. Insulation should extend to screw head.
 - b. *Broken line to limit control.* Check back to meter with test lamp.
- C. Differential set too close. This applies especially on vapor heating systems.
- D. Set too low.
- a. *Some systems use higher temperature or pressure than others in cold weather.* If limit control be set too low, rooms will never come up to heat.
 - b. *Check setting on control with temperature or pressure shown on boiler gauge.* Control may be out of calibration.
- E. Set too high.
- a. *If pressures or temperatures be carried too high,* many times the system will continue to deliver heat after thermostat is satisfied. Settings differ on each job. Check domestic hot water control.
- F. Location—Cuts off too low or too high.
- a. *Applies mostly to surface type switches.* Some hot water systems having two risers and two returns have two distinct circuits of different water temperature. Check the temperature of both risers and if one be much different from the other, relocate switch.

- G. Contacts fail to open.
See "Note" under II, A, page 275.
- a. *Mechanism stuck* by dirt, hardened grease, or foreign objects. Clean parts thoroughly. DO NOT OIL.
 - b. *Contacts welded together.* Locate cause of overload, then install new Magneseal contact unit.
 - c. *Hot Water—Immersion control—tubing broken,* or kinked, and charged trapped in one end. Straighten tubing if possible, or install new control.
- H. Wiring shorted at connections. No bare wire should show from under binding screw.
- I. Improper wiring. See wiring data. Limit control should break hot (black) line before it is run to stack switch. If burner continue to run with limit control open, there is a ground in the system.
- ### III. STACK SWITCH
- A. Relay will not pull in.
- a. *Blown fuse.* Determine cause before replacing.
 - b. *Thermostat trouble.* (See above.)
 - c. *Limit Switch trouble.* (See above.)
 - d. *Loose wiring connections.* Tighten all binding screws. Make sure that wires are clean and bare under screw head.
 - e. *External wiring incorrect.* See inside cover of stack switch.

- f. *Stack Switch in hot position.* Return helix actuated contacts to cold or starting position. Be sure that contacts are clean.
 - g. *Safety switch contacts not closed properly, or dirty.* Clean contacts with piece of coarse paper. Make sure that bimetal latches firmly.
 - h. *Defective transformer.* Test with buzzer between W and R terminals. If the line voltage (primary circuit) be complete and there be no circuit between W and R terminals (secondary circuit), replace control with new one.
 - i. *Broken or defective safety heater coil.* Use a jumper across the low voltage relay contacts (on panel under left side of relay armature). Making or breaking this circuit should give a spark if the heater be good. If not, replace.
 - j. *Defective relay coil.* Set thermostat low so that contacts will be open. Test with buzzer between R and W terminals on stack switch. If defective replace with new control.
 - k. *Low voltage condition.* Test supply circuit from meter with volt meter. Relay will not pull in if excessive voltage drop occur (below approximately 90 volts, on 110 volt service).
- B. Relay pulls in but motor does not start.**
- a. *High voltage contacts bent, dirty, or burned away.* If contacts be bent or burned badly, it indicates a probable overloaded condition. Locate cause of overload and replace with new control. If contacts be dirty, clean with a coarse piece of paper. (Never use file, sand paper or emery cloth.)

- b. *Loose wiring connections.* Tighten all binding screws; make sure all wire under screws is bare and clean.
 - c. *Wrong external wiring connections.* Check installation with wiring diagrams in Chapter 29, or wiring diagram inside control cover.
- C. Stack switch shuts down on safety.**
- a. *Warp switch timing too short.* To check safety timing proceed as follows: Make sure that stack switch is in the cold or starting position. Remove from stack. After burner motor starts, safety shutdown should occur between 90 and 120 seconds. It is not necessary to change the adjustment if timing be 5% above or below 90 or 120 seconds. If timing be considerably less than 90 seconds, stack switch should be returned to the factory for inspection and adjustment.
 - b. *Installed in too cold position in stack.*
 1. Too far from boiler.
 2. Too near draught regulator, damper, or elbow. Fifteen inches is minimum desired distance from these objects.
 3. Air intake slot on stack switch shank open too wide. Relocate stack switch in hotter position where temperature rise is not less than 100° F. in three minutes and where no elbow, damper or draught adjuster interferes with the flow of gases against the helix. CAUTION: DO NOT LOCATE WHERE TEMPERATURE ON THE HELIX WILL EXCEED 1100° F. Burner should go into running position in one minute. Check air intake shutter. Most boiler-burner units of late design operate

at much lower stack temperatures; for this reason the air intake shutter should be normally closed.

- c. *Installed so that helix is wedged against stack pipe.* Helix must be absolutely free to rotate from changes in stack temperature.
- d. *Helix badly warped, burned, broken, or dirty.* If broken or badly warped, replace with new helix. If burned, it indicates that stack switch has been mounted in too hot a position. Stack switches should be removed occasionally, and soot and carbon removed from helix with wire brush.
- e. *Low voltage contact on relay does not make or is dirty.* Relay will drop out as soon as it reaches the hot position; helix cools off; burner starts again. Repeated operations in this manner will cause safety shut-down. Clean contacts carefully. If badly bent, install new control.
- f. *Ignition failure.*
 1. Loose wiring connections. Tighten all binding screws. Keep bare wire under screws.
 2. Ignition contact on relay bent, burned or dirty. Clean thoroughly. If bent or burned, install new control, after finding cause of overload.

D. Relay fails to open contacts.

- a. *Bearing stuck with grease, dirt or wires folded into case wrong.* Clean carefully. DO NOT OIL.
- b. *Thermostat wire shorted between R & W terminals.* Make sure there are no bare wires sticking out from under binding screws. Check wiring back to thermostat.

- c. *Contacts welded together.* Install new control after finding cause of overload.
- d. *Internal short circuit.* Install new control if relay will pull in with no connection between R & W.

IV. HOT WATER CONTROL

Complaints include not enough or too much hot water. When there is a call of no hot water, the cause will be found under "NO HEAT."

A. Unsatisfactory temperature of domestic hot water.

1. Control set too low or too high. Settings vary with each job according to size of heater and tank and water used. Generally about 150° F.—170° F. is recommended.
2. Located in particularly hot spot or cold pocket where proper regulation is impossible. Relocate control.
3. Mechanism in control binding because of grease or dirt. Clean all parts thoroughly. DO NOT USE OIL.
4. Calibration of control "Off." Check water temperature with thermometer, against setting of control.

V. FUEL CONSUMPTION

This is the complaint that requires more tact and diplomacy on the part of the serviceman than any other call. Before any answer is given to the owner, all factors affecting oil consumption should be thoroughly checked, right back to the original inspection. Make sure user has correct understanding of how

much fuel should be consumed over any given period. The following chart may be used as a standard of comparison:

PERCENTAGE OF FUEL USED FOR
HEATING MONTHLY*

September.....	1.4%	January.....	18.5%
October.....	6.6	February.....	17.0
November.....	11.5	March.....	15.0
December.....	17.0	April.....	8.0
May.....	5.0%		
TOTAL.....	100.0%		

*NOTE.—These are average figures for normal weather conditions. The Weather Bureau in your city can tell you whether any month has been over or under normal and how much.

The control troubles that might cause, or help to cause a high oil consumption complaint, are the same as indicated under complaints "Not Enough Heat" and "Too Much Heat." However, assuming that the installed radiation and heating plant are sized correctly, and the firing rate adequate, control troubles have much less effect on oil consumption than the habits of the user in operating the system. If it appear that an excessive amount of oil has been used, and a careful check of the system failed to disclose any operating defect, these points should be checked with the owner:

1. Holding excessively high temperatures.
 - a. Night.
 - b. Day.
2. Frequent and prolonged opening of windows and doors.
3. Closing of fireplace dampers.

4. Preparation of fuel consumed in different months.
5. Possible difference between the owner's house and that of his neighbor who uses less fuel.
6. Closing off unheated rooms.
7. Original estimate of fuel consumption.

VI. ELECTRICAL INTERFERENCE

Generally speaking, the burner is seldom the cause of noise in a radio. It is more often other electrical equipment either in the house or nearby, such as washing machines, transformers, bad connections, refrigerators, vacuum cleaners, etc. Before doing any work, check operation of radio, with and without the burner operating. (See Section VIII, A, below.)

VII. ELECTRIC COST

This type of call is comparatively uncommon, but it is troublesome when it does come. Any condition present in the system causing the equipment to operate too often will increase the amount of electricity used. This complaint many times occurs in conjunction with the preceding high oil consumption complaint, and may be traced to the same causes in these cases. It is a good idea to pull the main switch at the meter, cutting off the supply to the house. Inspect meter, and if it show any movement, the public service company should be called. Grounds in the system may cause the meter to turn even when no equipment is operating. Close main switch, shut off all lights, clocks, and other equipment. Check meter. If it be still moving, some part of the system is grounded. Disconnect heating system circuit. If meter stop, trouble lies in heating system circuit.

VIII. ALL CONTROLS

A. Radio Interference — Noise in radio.

a. *Contacts not closing with proper snap action.*

1. Weak relay coil on stack switch. Relay chatters as it tries to pull in. Replace control.
2. Dirty contacts on relay armature. Just enough dirt to cause intermittent make and break of circuit. Clean carefully.
3. Contact blades bent by rough handling. Install new control.
4. Dirt in relay mechanism between relay armature and magnet core. Clean. **DO NOT OIL ANY PARTS.**

b. *Overload causing excessive arcing when breaking contacts.* Determine cause of overload. If not remedied, this condition will result in either burned out motor or some other "No Heat" call besides burning up the contacts.c. *Low voltage condition causing relays to chatter.* Check with voltmeter.

B. Noise and Vibration.

a. *Not rigidly mounted.*b. *Loose screws, bolts, or covers.*c. *Dirt or other foreign matter between relay armature and magnet core causing chattering action.*d. *Low voltage condition causing hum.*