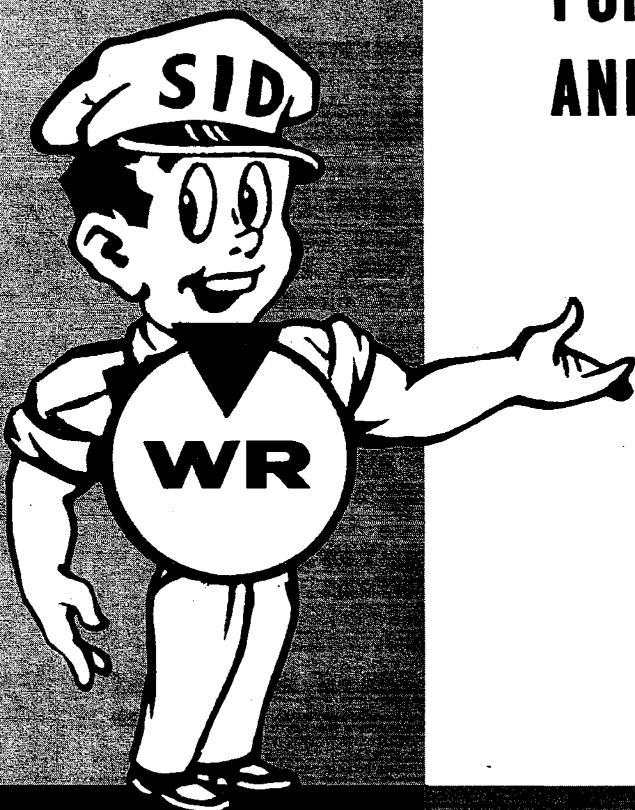
THERMOSTATS

FOR RESIDENTIAL HEATING AND COOLING



[illegible] HEATING DIVISION

WHITE-RODGERS

DIVISION OF EMERSON ELECTRIC

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This Training Course on Thermostats is is part of a continuing program for the Heating, Refrigeration and Air Conditioning Industry. White-Rodgers would like to present you with a Certificate of Award for participating in this course. To receive your certificate you must answer a few questions to show that you have read the text and understand its contents.

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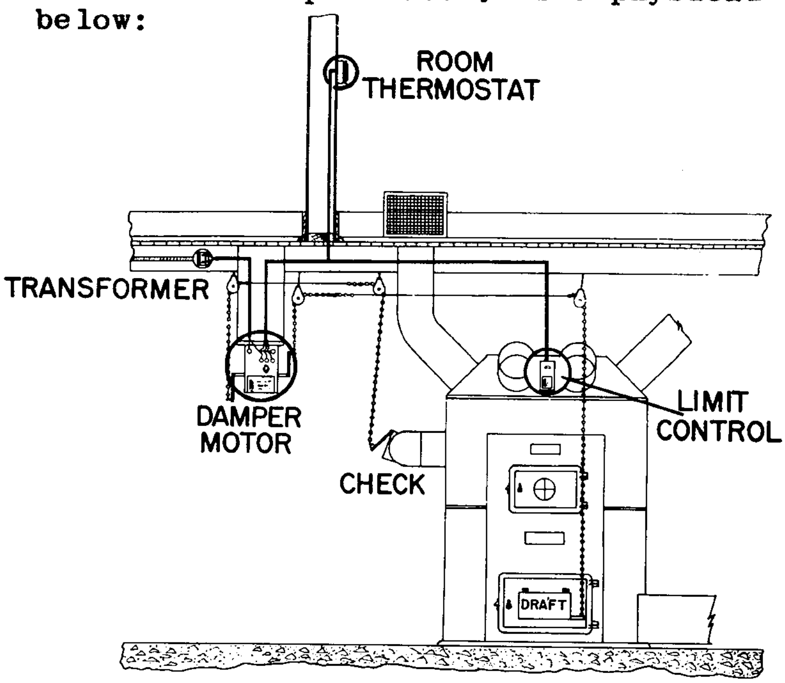
In this booklet we will review room thermostats, how they operate and some of the many types that are in use in control systems of today.

Because the use of thermostats in commercial and industrial applications can become quite complex, we will limit our discussion to residential heating and cooling systems.

In its simplest form, a thermostat is a device which responds to air temperature changes and causes a set of electrical contacts to "open" or "close". This is the basic function of a thermostat, but there are many different types designed to perform a variety of switching functions.

One of the early types of heating systems which was capable of some degree of automatic control was the hand fired coal furnace. Thermostatic control of this system was accomplished with a S.P.D.T. thermostat and a damper motor. The physical layout of this system is shown below:

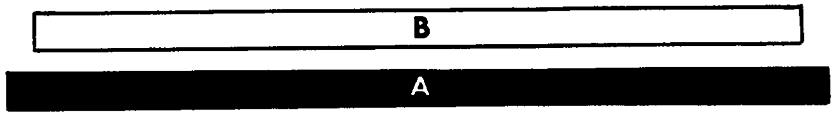


When the thermostat called for heat, the damper motor shaft would turn, opening the draft damper which would increase the combustion in the fire box. When the room thermostat was satisfied, the draft damper would close and the check damper would open which would tend to retard combustion. This was a long way from the completely automatic systems of today, but it was the begining of automatic control for residential heating systems.

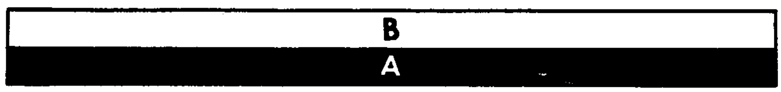
The heart of this early system as well as the most modern systems of today is, of course, the room thermostat. So we will begin with the bimetal room thermostat.

The bimetal room thermostat gets its name from the fact that it uses a bimetal to open or close a set of contacts upon an increase or a decrease in room air temperature. Just for the sake of review, let's look at how a bimetal works. A bimetal is two pieces of metal, which, at a given temperature, are the same length.

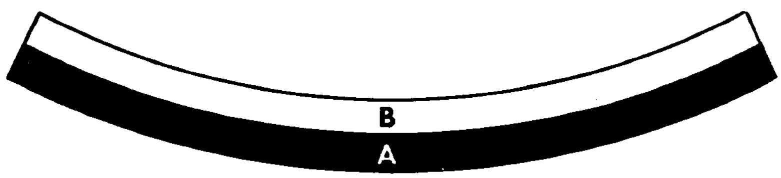
If we increase the temperature of these two pieces of metal, one will become longer than the other. This is because they are different metals having different rates of expansion.



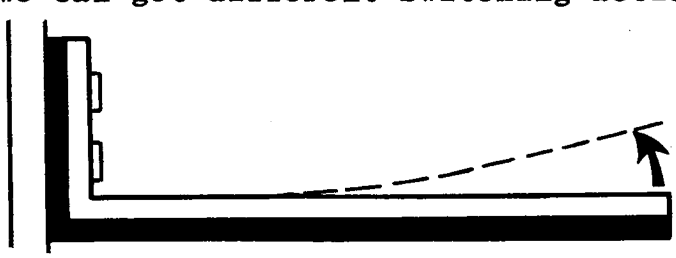
To make these two different metals work for us, we weld them together in such a way that they become one solid piece, but they still keep their individual characteristics of different rates of expansion.



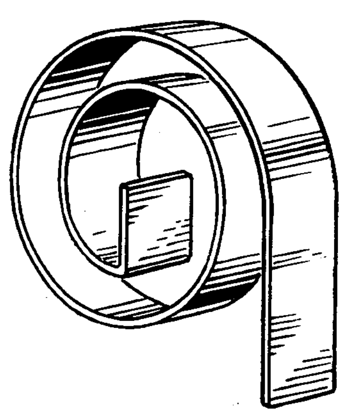
Now when we apply heat, metal "A" still expands at a faster rate than metal "B". In order for metal "A" to become longer, it must bend the entire piece into an arc.



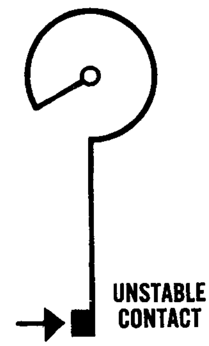
We now anchor one end of the bimetal to something solid, and the free end will now move down or up with an increase or decrease in temperature. By attaching contacts to the free end and placing other stationary contacts nearby, we can get different switching actions with changes in temperature.

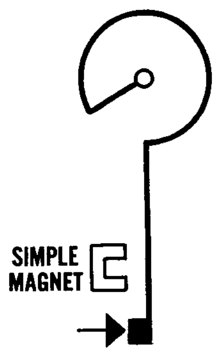


In low voltage bimetal thermostats we want as much bimetal area as possible to be exposed to the changes in room air temperature. We do this by forming a long piece of bimetal into a small coil.



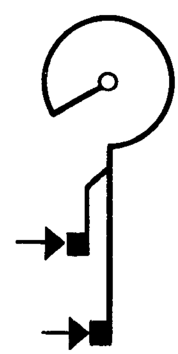
The first bimetal room thermostats produced unsatisfactory results due to the unstable action of the contacts. Due to the relatively small difference in room air temperature the bimetal could not develop enough contact pressure to obtain a positive electrical connection. The unstable contact action is shown to the right.

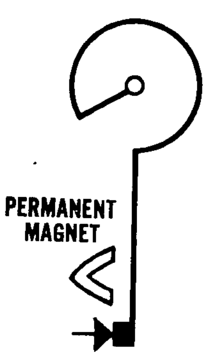




The next step was to place a simple magnet near the bimetal arm. As the bimetal would bend toward the stationary contact it would come into the magnetic field, causing the contacts to "snap" closed. However, simple magnets lost their magnetism after a period of time and we were right back to the unstable contact condition we had as shown above.

The next development was the holding circuit design. This particular design incorporated two sets of contacts, one set for "pull-in" and the other for "hold-in". This system was effective in overcoming the objections of the unstable contact type, although it did require a three wire circuit.



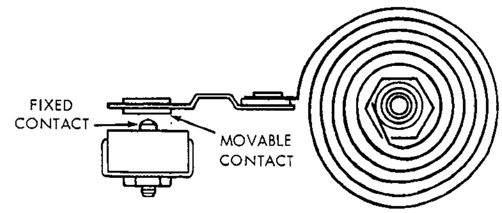


With the development of the permanent magnet we were able to return to the convenience of the two wire control system incorporating the best features of modern control circuits.

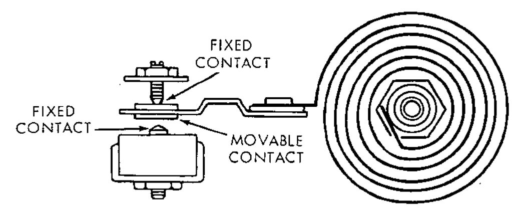
Snap Action vs Mercury Switch:

White-Rodgers Astro*Stat thermostats are available with either "Snap-Action" or "Mercury" switches. A brief description of each type is given below:

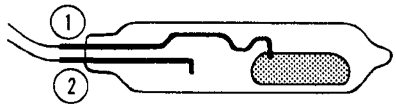
"Snap-Action" switches are constructed with a "fixed" contact securely attached to the base of the thermostat. This contact is mounted inside a round permanent magnet which provides a magnetic field in the area of the contact. The movable contact is attached to the bimetal and upon a decrease in temperature (on heating models) it will move slowly toward the fixed contact. As the movable contact enters the magnetic field around the fixed contact, the magnetic field "pulls" the movable contact against the fixed contact with a positive "snap". Because the movable contact has a "floating" action, it closes with a clean snap, without contact bounce. This "floating" action also eliminates any tendancy for the contacts to "walk" while opening.

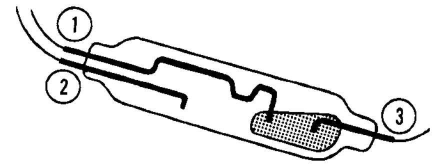


As the bimetal becomes warmer (on a heating model) it wants to pull the movable contact away from the fixed contact. Because the movable contact is in the magnetic field surrounding the fixed contact, the bimetal does not (at this instant) have enough force to overcome the magnetic field. As the bimetal continues to warm-up and bend, it soon develops enough force (torque) to overcome the magnetic field and the movable contact breaks away with a positive "snap". When we use S.P.D.T. switch action, another fixed contact is used and located so that when we break one contact, we make another. All "snap-action" thermostats are supplied with a dust cover to prevent dirt and other contaminants from getting on the contacts. Should it be necessary to clean these contacts, never use a file or sandpaper. A clean business card or smooth cardboard (book match cover) should be inserted between the contacts. With gentle pressure on the movable contact, pull the card back and forth to clean the dirt or film from the contacts.

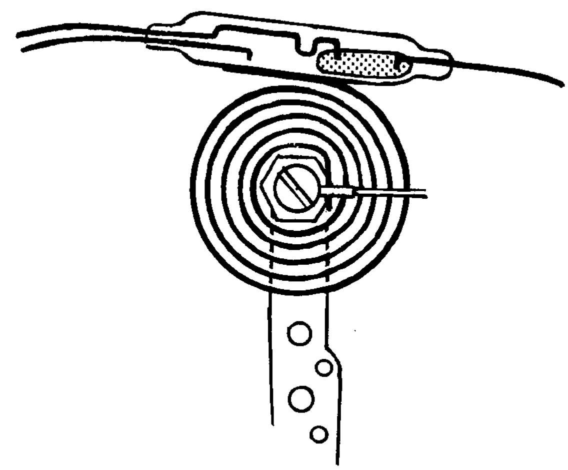


"Mercury" switches perform the same switching function as "snap-action", but the switching action is accomplished by a "globule" of mercury moving between two or three fixed probes sealed inside a glass tube. Two probes are used on S.P.S.T. switches while three probes are used on S.P.D.T. models.





These "mercury" tubes are attached to the thermostat bimetal. On a S.P.D.T. model, as the temperature falls, the bimetal moves counter-clockwise and the bulb tilts to the left, breaking contact between terminals 1 and 3 and making contact between terminals 1 and 2. As the temperature rises, we break 1 and 2 and make 1 and 3.



On S.P.S.T. models, terminal 3 is not used and we have a simple switch making and breaking contact between terminals 1 and 2.

The Thermostat and the System:

In any type of heating system, the success of the thermostat depends on several factors. First, the heating system must be of the right size (B.T.U. output) to meet the needs of the area being heated. Second, the air distribution system must be properly designed and installed so that there is even air distribution to all rooms. Third, the thermostat must be located so that it can "feel" the average air temperature in the area being heated.

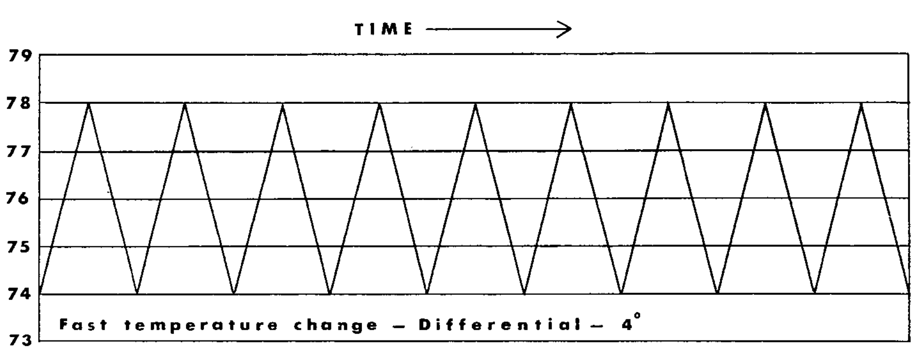


Fig. 1

By having an improper balance of heating system size, thermostat location or air distribution we might expect a fast temperature change in the area being controlled. These conditions could result in a wide temperature differential as shown in Fig. 1.

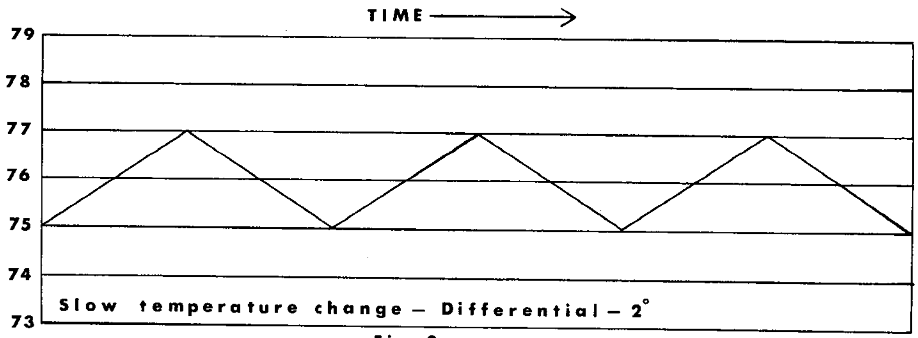


Fig. 2

However, when we properly size the heating plant, balance the air distribution and properly locate the thermostat, we will have a slower temperature change and thus a narrower differential as shown in Fig. 2.

Forced Warm Air System - Non-Anticipated Thermostat:

The temperature lever on the thermostat is set at 75°F, the furnace has been off for some time and the room air temperature is dropping slowly. The bimetal element has been following the air temperature change and will close the electrical contacts at 75°F. This causes the heating system to start. At this moment no warm air is being delivered to the room because the heating system must "warm-up" to the "fan-on" setting on the fan control.

While the heating system is "warming-up", the room air temperature will continue to drop slowly. Depending on the type of heating system, the room air temperature will drop to 74 1/2°F, 74°F or more before the blower comes on and the warm air is "felt" by the thermostat bimetal. This difference in temperature between the point at which the thermostat contacts close and the point the air temperature at the thermostat starts to rise is known as "system lag". The amount of "system lag" in degrees F will depend on the thermostat location, type and size of the furnace and the design of the air distribution system.

With the furnace "on" and the blower running, the room air temperature will continue to rise. If the thermostat has a mechanical differential of 2°F, the electrical contacts will open at 77°F and shut down the primary control on the furnace. However, the furnace is still "hot" and the blower will continue to deliver warm air to the room until the furnace temperature drops to the "fan-off" setting on the fan control. The additional heat that has been delivered to the room after the thermostat contacts have opened is called "overshoot". This "overshoot" can carry the room air temperature to 77 1/2°F, 78°F or higher.

The effect of "system lag" and "overshoot" are shown in Fig. 3 on the following page.

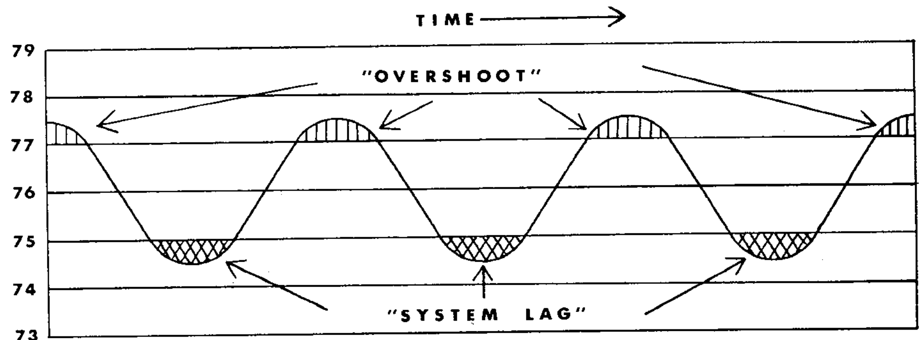


Fig. 3

Forced Warm Air System - Anticipated Thermostat:

To reduce the wide differential resulting from a Non-Anticipated thermostat, we simply add a small amount of heat to the bimetal element so that it is slightly warmer than the surrounding room air temperature. We do this by placing a resistor in the thermostat close to the bimetal element. This resistor is in series with the contacts. When the contacts close and the primary control is energized, the current flowing through the primary control must also flow through the resistor. The current flowing through the resistor causes it to heat-up, which in turn heats the bimetal element. Thus, we "anticipate" the point at which the thermostat contacts should open to give us a narrow differential.

With the same setting of 75°F as in the previous example and the furnace "off", the bimetal element temperature is dropping slowly. When the bimetal element temperature reaches 75°F the contacts close, turning the furnace "on". At this point the anticipating resistor begins to heat-up, which in turn heats the bimetal element.

The room air temperature will drop slightly before the blower comes on and warm air is delivered to the room. The room air temperature now begins to rise, but the bimetal element is warmer than the surrounding air due to the heat from the anticipating resistor.

With the same mechanical differential of 2°F, the thermostat contacts will open when the heat from the anticipator raises the bimetal temperature to 77°F. The room air temperature at this point may be 75 1/2°F and rising.

Because the furnace has been "on" a shorter period of time, there is less heat left in the heat exchanger. This means we will have less "overshoot". In the meantime, the bimetal element is cooling down because it is no longer being heated by the anticipator. Thus, we begin the cycle all over again.

Wehave not eliminated "system lag" or "overshoot", but through the use of "heat anticipation" we reduce these factors to the negligible point. Through proper system design and thermostat location, it is not unusual to obtain 1/2°F room air temperature differential by the proper use of "heat anticipation". See Fig. 4, below.

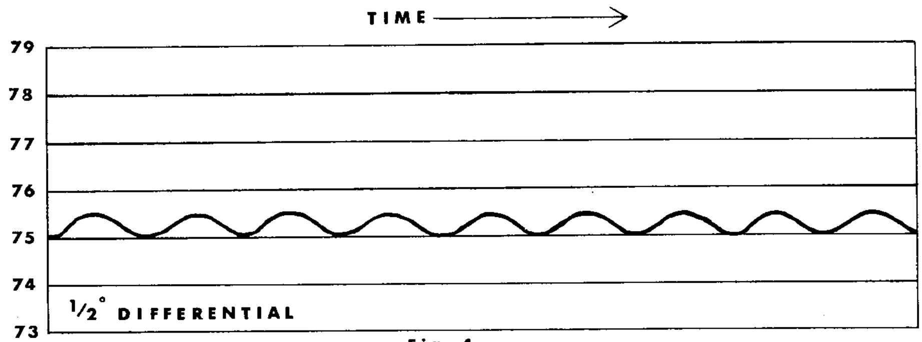
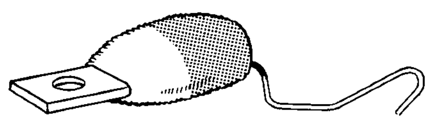


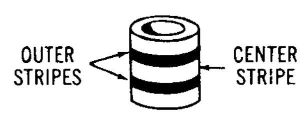
Fig. 4

Types of Heat Anticipators:

Heat anticipators are made in two types: Fixed and adjustable. A fixed anticipator can be either wire wound or the carbon resistor type. Earlier models of White-Rodgers low voltage thermostats used the wire wound fixed anticipators. They were dipped in an insulating material and color coded to indicate the current draw of the primary control with which they were to be used.



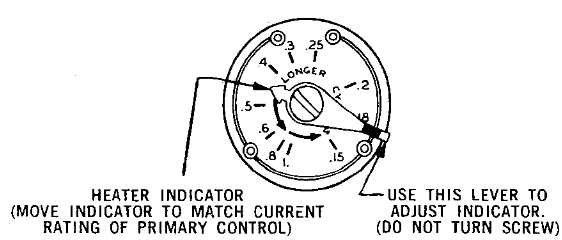
Present day White-Rodgers thermostats with fixed anticipators use a tubular resistor which is also color coded to indicate the current draw of the primary control. These are supplied as either "non-removable" - (riveted in place) or "removable" - (attached with a screw). Fixed anticipators must match the current draw of the primary control. A number of different ranges are available.



The most versatile heat anticipator is, of course, the adjustable type. Again, White-Rodgers offers the widest range of any adjustable anticipator on the market today. With our standard anticipator you can match the current draw of any primary control from .15 to 1.0 amps.

How to Set an Adjustable Anticipator:

The primary purpose of the White-Rodgers adjustable anticipator thermostat is to provide a single thermostat to match almost any type of primary control in the field today. Before installing the thermostat, check the nameplate on the primary control. Make sure that the primary control is a low voltage model (25 volts), not line voltage! A low voltage thermostat will burn out immediately if connected to a line voltage primary control! If, for example, the nameplate tells you that it is a low voltage control and the "CURRENT" is marked .45 amps, set the indicator on the



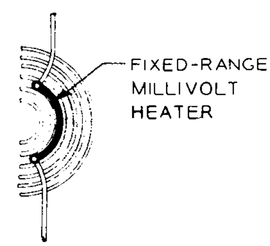
adjustable anticipator to .45 amps. By matching the adjustable anticipator to the current rating on the primary control you are assured of the best possible heat anticipation for the system.

Occasionally you may find a system where longer or shorter cycles of the primary control are desirable. If you want to change the cycle for the heating system you can make a simple adjustment on the anticipator to do this. If the primary control draws .45 amps and you want a longer cycle, set the anticipator to .5 or .6 amps. This puts less resistance in the circuit. With less resistance, but the same current (from the primary control), you will generate less "false" heat and get a longer cycle of the primary control.

If a setting of .45 amps on the adjustable anticipator gives a cycle that is longer than desired, re-set the indicator to .3 or .25 amps. This will put more resistance in the circuit and thus generate more "false" heat for shorter cycles.

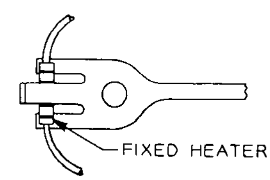
Millivolt Systems:

Because of the small voltage developed by a self-generating system, the anticipator must be small so as not to create too great a voltage drop. Also, because the anticipator produces a very small amount of heat, it must be placed against the bimetal as shown. Anticipators of this type are recommended for use with 750 mv systems only.

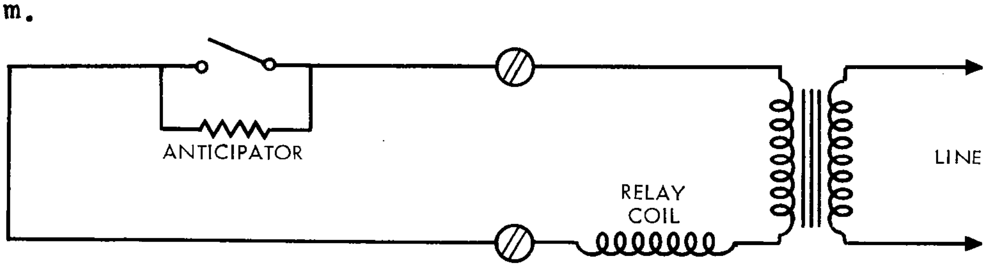


3-Wire Zone Valves and Cooling Anticipators:

Thermostats designed for 3-wire zone valves and cooling applications employ a different type of anticipation.



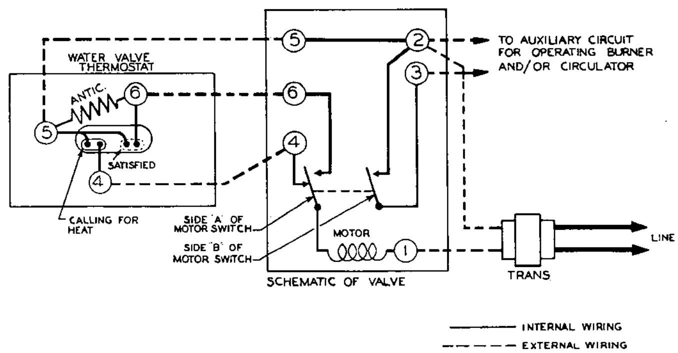
This anticipator is a 1/4 watt carbon type resistor similar to that found in a radio or TV set. This type of anticipation is known as "off-cycle anticipation". To better understand this type of anticipation, let's look first at how it is used in a typical cooling system.



In a cooling system we add heat to the thermostat bimetal during the "off" cycle. This is just the opposite of heat anticipation in a heating system. The anticipator in a cooling system is in parallel with the contacts of the thermostat. When the contacts close, this provides a low resistance path for the current in the thermostat circuit and "pulls-in" the relay on the air conditioning system. When the thermostat is satisfied, the contacts open. We now have a high resistance path from the transformer, through the cooling anticipator, the winding of the relay coil and back to the transformer. Because we have a high resistance in the cooling anticipator, it drops the voltage to the point that the relay will not pull-in.

The current flowing through the cooling anticipator heats up the thermostat bimetal. This causes the bimetal to be warmer than the surrounding room air temperature which is also rising (system off). This "false" heat causes the contacts to close before the room air temperature reaches the "cut-in" point. Thus, we bring the cooling system on sooner, reduce "system lag" to a minimum and provide a narrow differential for the cooling system. Cooling anticipators are provided on all White-Rodgers low voltage cooling thermostats and on combination heating and cooling models.

Three-wire zone valve thermostats also use anticipators similar to those used in cooling thermostats. When the thermostat calls for heat, the low voltage circuit is completed from the transformer to terminal 1 of the zone valve, through the motor winding, side A of the motor switch to terminal 4 of the zone valve and thermostat, through the mercury cell of the thermostat, back through terminals 5 and 2 of the zone valve and back to the other side of the transformer. The motor is now operating and the valve is opening. When the valve reaches full open position, side A of the motor switch now changes the circuit from terminal 4 to terminal 6. Since the thermostat is calling for heat, the mercury is on the left side of the cell (terminals 4 & 5) and we cannot make contact between terminals 6 & 5 except through the anticipating resistor.

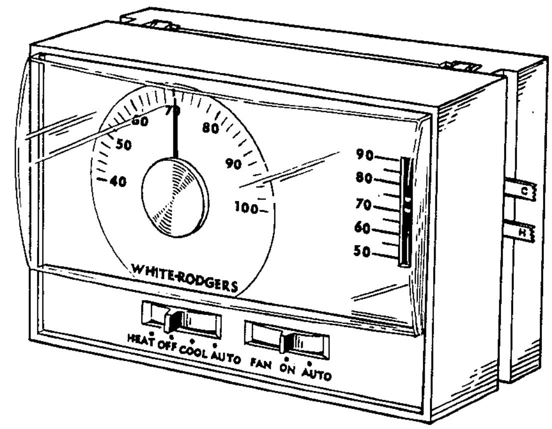


As the current flows through the anticipating resistor we have a high resistance circuit which creates a sufficient voltage drop to prevent the motor from running. The motor now stops with the valve in the open position. The anticipator is now heating-up the bimetal. When the bimetal reaches its switching point, the mercury cell tilts to the right. We now break the circuit between 4 & 5 and make the circuit between 6 & 5. This gives us a low resistance circuit which by-passes the anticipator and the motor is running again. When the valve reaches the closed position, side A of the motor switch breaks contact with terminal 6 and makes contact with terminal 4. We now have an open circuit between 4 & 5 and the motor stops. The motor will remain stopped until the mercury cell tilts to the left on the next call for heat.

Heat anticipators not only provide a narrow operating differential on room thermostats, but they also enable us to perform some interesting switching actions.

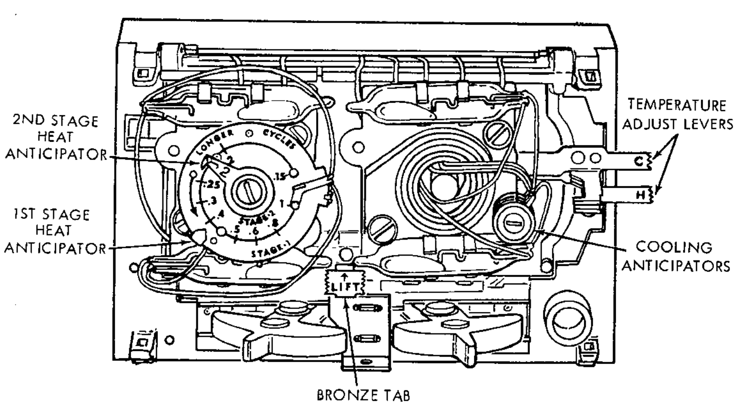
Staging Thermostats:

In recent years there has been an increased demand for better comfort and efficiency in indoor comfort systems. The White-Rodgers Staging Thermostat has been designed to meet these needs with several "plus" features which appeal to the engineer and the serviceman.



The staging thermostat is used on those systems which are designed for one or two stages of heating or one or two stages of cooling or any combination of heating and cooling.

In a "typical" system of two stage heating and two stage cooling, when the thermostat is in the "heat" position, the heating system would operate at a reduced B.T.U. input level during mild weather. As the weather became colder, this reduced level of input would not be sufficient to maintain the desired comfort level and the thermostat would automatically bring on an additional level of input to the heating system. This could be either two separate furnaces or a single furnace designed with two separate input levels. In the "cooling" position the situation would be similar except that we would be bringing on one or two levels of cooling instead of heating. These thermostats are also available with "automatic changeover". In the automatic position all that is necessary is to set the desired level of heating and cooling. The thermostat will automatically change the system over from heating to cooling and back to heating, based on the temperature settings on the thermostat. There are two separate temperature levers on these thermostats, one marked "C" for cooling and the other marked "H" for heating.



Inside this "typical" thermostat are four mercury switches. Two for heating and two for cooling. Adjustable heat anticipators are provided for both stages of heating. Fixed anticipators are also provided for both of the cooling stages. The nominal differential between heating and cooling is 3°F and this is a positive interlock. This means that heating and cooling cannot operate simultaneously.

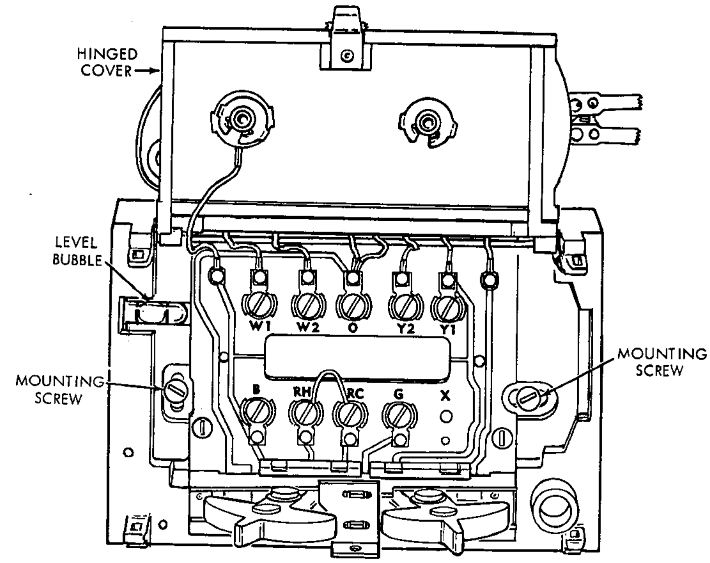
Multi-stage heating and cooling systems are more sophisticated and require special features in a thermostat that are not found in conventional systems.

We have made provision for the feature of "malfunction light" (lower right hand corner). This would be used on a heat pump installation to indicate to the homeowner a malfunction of the compressor. A D.P.D.T. emergency switch is also provided on this model to operate a relay which would bring on emergency strip heaters, on demand from the thermostat. Thus, auxiliary heating would be available on this system even in the event of malfunction of the main heating system (heat pump).

The use of the light in the thermostat is not limited to a "malfunction light". It can be field wired to indicate the operation of any of the components of the system. The equipment manufacturer will indicate in his instructions the function of this light, whenever the thermostat is supplied with this feature.

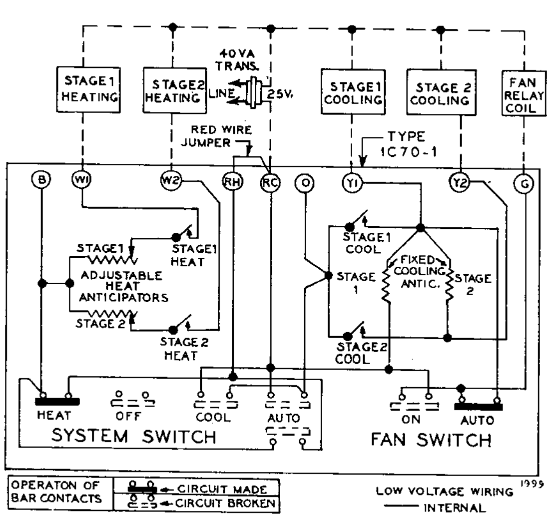
Hinged Cover:

One of the more attractive features of the staging thermostat is the ease of installation. By lifting the bronze tab the cover containing the bimetals & mercury switches can be raised to the upright position. This reveals the wiring panel and mounting holes. There is no need for sub bases or mounting plates. The base also has a level bubble to properly level the thermostat before tightening the mounting screws.



Circuit Wiring:

The circuit wiring with staging thermostats will, of course, vary from installation to installation due to the number of possible systems that can be used. We will use a two stage heating-two stage cooling wiring diagram to review thermostat function. From the diagram below we can see that the system switch is on heat and the fan switch is on auto. From one side of the transformer the circuit is to terminal RC, through the jumper wire to RH, through the internal wiring to the bar contact on "heat" and on to stage 1 and 2 heat anticipators. You will note that we also have a circuit to terminal B which will energize another circuit continuously.Upon a call for heat, stage 1 heating switch will close which gives us a circuit to W1, to the first stage of the heating system and back to the other side of the transformer. If the temperature continues to drop, stage 2 heating switch will close which gives us a circuit through W2, to the second stage of the heating system and back to the other side of the transformer.



When the selector switch is placed in the "cool" position we break the "heat" bar contact and make the "cool" contact. This gives us a circuit from RC to the "cool" contact, through the internal jumper to the "auto" contact and on to stage 1 and stage 2 contacts. When stage 1 contact closes we have a circuit through Y1, stage 1 cooling and back to the other side of the transformer. If this is not sufficient cooling, stage 2 contacts close and this circuit is made through Y2, stage 2 cooling and back to the other side of the transformer.

Additional circuits are available on request.

Thermostat Location:

We have mentioned earlier that thermostat location is very important to the successful performance of the total system.

For your guidance, we offer the following suggestions for proper location of the thermostat.

- Always locate the thermostat on an inside wall. If it is located on an outside wall, overheating during cold weather is likely to occur because the thermostat will always feel cold.
- Avoid false sources of heat such as lamps, TV sets, warm air ducts or hot water pipes in the wall, and locations where heat producing appliances like ranges, ovens, dryers, etc. are located on the opposite side of the wall. Locations near windows may cause direct sunlight to reach the thermostat.
- Placing the thermostat in the direct air stream of a warm air register will cause the room to be colder.
- Avoid sources of vibration like sliding doors, closet doors and room doors. Always locate the thermostat at least 4 feet from such sources of vibration, and near a wall support, if possible.

Calibration Adjustment:

All White-Rodgers thermostats have been carefully adjusted at the factory and should not require re-calibration. A few degrees difference between the indicator setting of the thermostat and the actual room temperature is not considered important. If the disagreement is appreciable, however, first make sure the thermostat is properly located and leveled. Then, if re-calibration still seems necessary, proceed as follows:

For Heating and Heating-Cooling Models:

These instructions apply for both heating and heating-cooling models, with either sealed mercury or snap-action contacts.

1. Move temperature adjustment lever to a setting about 5° above room temperature.
2. Remove thermostat cover. Slip calibration wrench (85-0019) onto hex nut beneath bimetal, and, holding temperature adjustment lever stationary, turn hex nut clockwise until mercury shifts to right end of tube (or until movable contact moves off of magnet on snap-action types).
3. Move temperature adjustment lever to lowest setting. (When re-calibrating heating-cooling model during cooling season, place Sub-Base or Selector Switch in "Heat" or "Off" position to prevent operation of cooling system.)

4. Replace thermostat cover. Wait 10 minutes for bimetal temperature to stabilize. Don't stand near thermostat during this period as your breath and body heat will affect temperature of bimetal.

5. Move temperature adjustment lever to correspond to actual room temperature. Then remove thermostat cover.

6. Slip calibration wrench onto hex nut, holding temperature adjustment lever stationary, turn hex nut counterclockwise until mercury just barely shifts to left end of tube (or until movable contact just closes against magnet on snap-action types). Then replace cover and set thermostat to desired temperature. (If Sub-Base or Selector Switch was changes in Step 3, return to "Cool" position.)

For Cooling Models:

These instructions apply for cooling models, with either sealed mercury or snap-action contacts.

1. Move temperature adjustment lever to a setting about 5° below room temperature.

2. Remove thermostat cover. Slip calibration wrench (85-0019) onto hex nut beneath bimetal, and, holding temperature adjustment lever stationary, turn hex nut counterclockwise until mercury shifts to left end of tube (or until movable contact closes against magnet on snap-action types).

3. Remove wire from terminal 5 on thermostat or wall plate (or place Sub-Base in "Off" position) to take cooling anticipator out of circuit.

4. Replace thermostat cover. Wait 10 minutes for bimetal temperature to stabilize. Don't stand near thermostat during this period as your breath and body heat will affect temperature of bimetal.

5. Move temperature adjustment lever to correspond to actual room temperature. Then remove thermostat cover.

6. Slip calibration wrench onto hex nut and, holding temperature adjustment lever stationary, turn hex nut clockwise until mercury just barely shifts to right end of tube (or until movable contact just moves off of magnet on snap-action types).

7. Replace wire removed in Step 3 (or return Sub-Base to "Cool" position). Then replace thermostat cover and set thermostat to desired temperature.

* * * * *

WHITE-RODGERS AUTOMATIC CONTROLS

THERMOSTAT TEST

Your name and address ______________________ Grade ____

PLEASE PRINT
USE ZIP CODE ______________________

This is an "open book" test. ie: you may use the Thermostats text when answering the questions. All questions are either "True-False" or "Multiple Choice".

1. The "floating action" of Snap Action thermostats:

   ___ a. eliminates the contact "bounce" on opening.

   ___ b. eliminates "walk" on closing.

   ___ c. widens the thermostat differential.

   ___ d. eliminates contact "bounce" on closing.

2. A "fine" sandpaper is recommended to clean thermostat contacts.

   ___ True ___ False

3. An oversized heating system:

   ___ a. would result in lower heating bills.

   ___ b. may cause a wide temperature differential.

   ___ c. should be installed only in a large house.

   ___ d. should be used if you live in a cold climate.

WHITE-RODGERS DIVISION
EMERSON ELECTRIC CO.
9797 REAVIS ROAD
ST. LOUIS, MISSOURI 63123
EMERSON

4. Anticipated thermostats are desirable because:

___ a. they provide a narrow temperature differential.

___ b. they use less electricity.

___ c. the heating system will last longer.

___ d. they provide a wide temperature differential.

5. Adjustable anticipator thermostats are more popular because they can match a wide range of primary controls.

___ True ___ False

6. If you want a longer cycle on a heating system, the adjustable anticipator should be set to a lower value than the amp. draw of the primary control.

___ True ___ False

7. For cooling anticipation, the anticipator should be:

___ a. in series with the thermostat contacts.

___ b. in parallel with the compressor relay coil.

___ c. in parallel with the thermostat contacts.

___ d. in parallel with the transformer secondary.

8. When using an anticipated cooling thermostat, current flows through the relay coil only when the compressor is running.

___ True ___ False

9. In three-wire zone valve thermostats, the anticipator is energized as soon as the thermostat calls for heat.

___ True ___ False

10. On a three-wire zone valve, current is flowing between terminals 5 and 2 :

___ a. only when the valve is closing

___ b. only when the valve is opening.

___ c. all the time.

___ d. none of the above is correct.

11. As a thermostat bimetal becomes warmer, it will:

___ a. open a set of contacts on a cooling thermostat.

___ b. close a set of contacts on a cooling thermostat.

___ c. close a set of contacts on a heating thermostat.

___ d. none of the above is correct.

12. "System Lag" can be eliminated by changing the thermostat to a lower setting.

___ True ___ False

13. The mechanical differential of a thermostat will vary, depending on the type of anticipator used.

___ True ___ False

14. On an anticipated heating thermostat, the bimetal temperature will be warmer than room air temperature when the thermostat is calling for heat.

___ True ___ False

15. One of the problems with early bimetal thermostats was that they developed too high a contact pressure.

___ True ___ False

16. If a millivolt thermostat with anticipator was accidentally connected to a 25 volt system, we would expect the thermostat to cycle rapidly.

___ True ___ False

17. Overshoot is found in cooling systems as well as heating systems.

___ True ___ False

18. Overheating during cold weather is an indication that the thermostat is:

___ a. located in the direct air stream of a register.

___ b. located on an outside wall.

___ c. near a window where it will be warmed by the sun's rays.

___ d. feeling the heat from a nearby lamp.

19. In the wiring diagram for the 1C70-1 staging thermostat, page 13, the fan relay coil will be energized when:

___ a. the "cool" circuit is made.

___ b. the "auto" circuit is made.

___ c. stage 1 cooling contact closes.

___ d. the FAN SWITCH 'ON' circuit is made.

20. Terminal "B" on the 1C70-1 thermostat will be energized only when the "auto" circuit is made.

___ True ___ False

When you have completed the test, return it to:

White-Rodgers
Training Division
9797 Reavis Road
St. Louis, Missouri 63123