CHAPTER 20

The Differential

It's perhaps a safe assertion to state that when they speak of the "differential" in connection with automatic control devices for oil burners, most people don't know what they are talking about—they are certainly not talking about the differential calculus.

Ques. What are they talking about?

Ans. They refer to an important phase or pause in the operation of an automatic control device, upon the extent of which, depends the resulting difference in *temperature* or *pressure*, accruing, that is, from the time the burner stops till it starts.

The differential part of the mechanism is adjustable so that the temperature or pressure differential may be varied, that is, it is provided with adjustments to set the operating range to start the burner on "low" and stop the burner on "high".

Ques. What are the basic principles involved in the differentail mechanism of an automatic control device?

Ans. A system of linkage forming a "knuckle" joint which snaps to one side or the other by the action of a spring, which in turn is governed by the action of another spring and a variable opposing force due to pressure or temperature changes.

Ques. Describe the differential mechanism.

Ans. In the elementary diagram fig. 1, it consists of a link **A**, pivoted at one end and engaging a spring **B**, at the other end, forming the knuckle joint. A connecting link **C**, is pivoted to the switch link **D**. A bellows **E**, and operating spring **F**, provide two opposing forces for the operation of the switch.

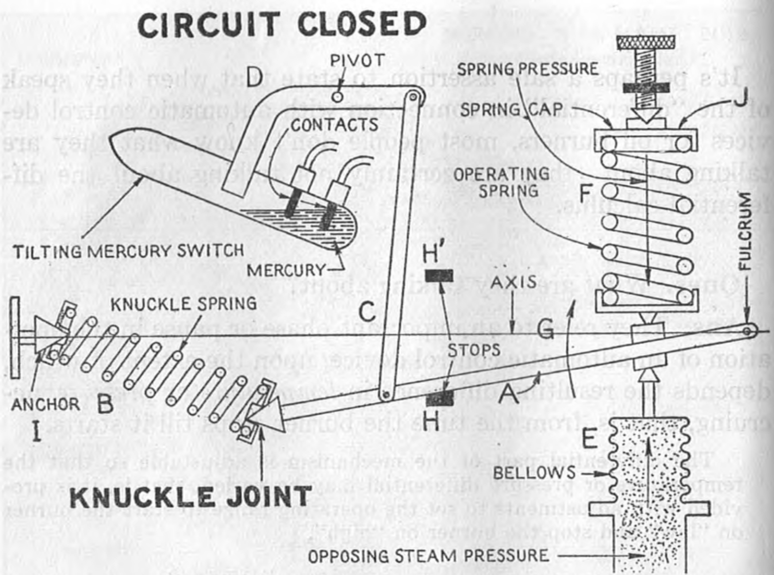


Fig. 1—Elementary diagram of differential mechanism for operating a tilting mercury switch showing essential elements; switch in ***closed position.***

Ques. How does it work?

Ans. In the position shown, the circuit is closed (switch on). The operating spring **F**, tends to keep the switch in the on

position, as shown. The pressure of the operating spring is opposed by the steam pressure tending to expand the bellows **E**. When the steam pressure becomes high enough to overcome the spring **F**, pressure, link **A**, will turn on its pivot in direction indicated by arrow **G**, and after passing the dead center axis, knuckle spring **B**, will "snap" the mechanism over to position where link **A**, contacts with the stop **H'**. This movement tilts

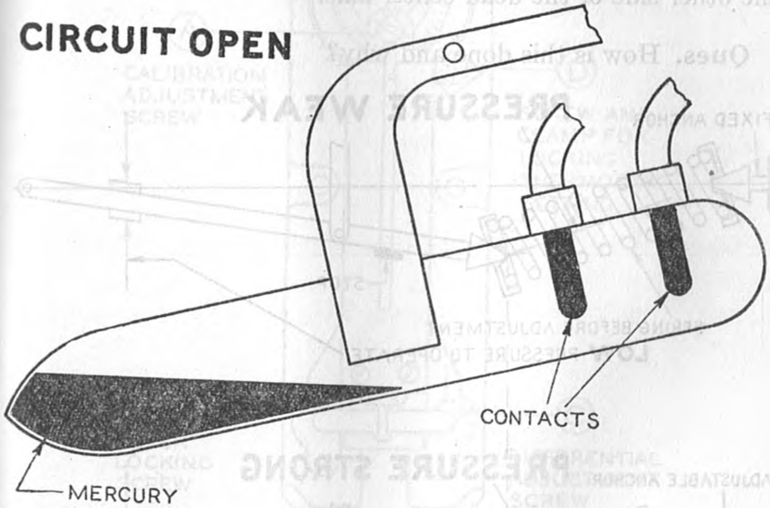


Fig. 2—Detail of tilting mercury switch showing switch tilted to open position.

the mercury switch, shifting the mercury to the other end and opening the circuit as shown in fig. 2.

It should be noted that the extent of movement between the stops **H** and **H'**, (fig. 1) is exaggerated to emphasize the basic principle of the knuckle joint.

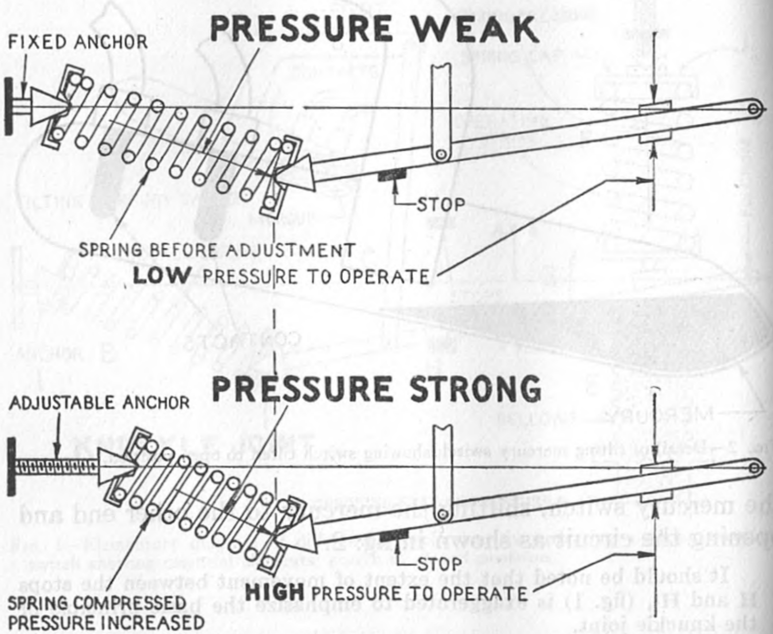
Ques. What is missing in fig. 1?

Ans. The mechanism has no provision for adjusting the differential period, that is, the time interval between start and stop of the burner.

Ques. What is provided to make this adjustment?

Ans. Means must be introduced to change the tension of the knuckle spring B (fig. 1) in order to increase the opposing steam pressure necessary to swing the knuckle joint over to the other side of the dead center axis.

Ques. How is this done and why?



Figs. 3 and 4—Detail of knuckle of differential mechanism. Fig. 2, non-adjustable type; fig. 3, anchor adjustment. Evidently when the knuckle spring is compressed as in fig. 4, it requires a higher steam pressure to snap the switch to the off position thus increasing the time interval between start and stop of the burner corresponding to the increased pressure differential.

Ans. Either by lengthening the link A, or the knuckle spring anchor I. The object of either method is to compress the spring so as to increase its tension.

The adjustable anchor method and how it works, is shown in figs. 3 and 4.

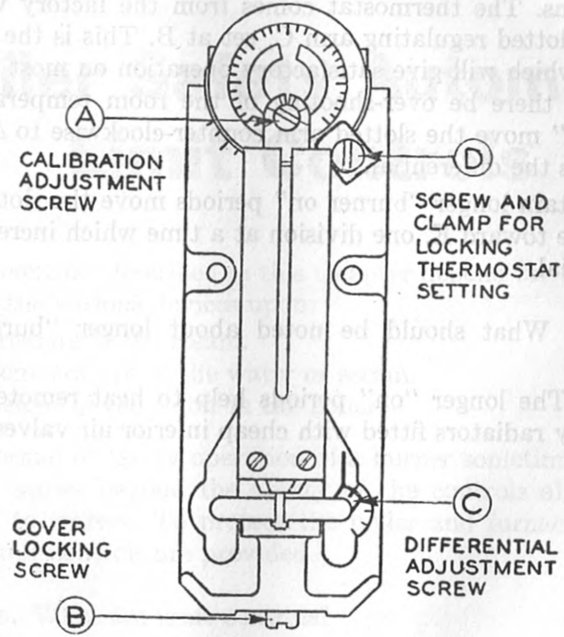


Fig. 5—Differential adjustment mechanism of Silent Glow Series 100 thermostat.

How the Differential is Adjusted in Practice.—To illustrate, a Twin Contact Series 100 thermostat is selected, as shown in fig. 5.

The following are instructions for regulating burner operations.

The thermostat, as it comes to you, will give close temperature control without the need of any field adjustment. However, where adjustment is necessary, it is a simple matter to adjust the differential as desired.

This thermostat has a simple device for regulating burner operations. The thermostat comes from the factory with the copper slotted regulating arm C, set at B. This is the average setting which will give satisfactory operation on most installations. If there be over-shooting of the room temperature or "cold 70" move the slotted arm counter-clockwise to A, which decreases the differential.

To obtain longer "burner on" periods move the slotted arm clockwise toward E, one division at a time which increases the differential.

Ques. What should be noted about longer "burner on" periods?

Ans. The longer "on" periods help to heat remote rooms, especially radiators fitted with cheap inferior air valves.