

[54] SOOT CLEANING METHOD
[76] Inventor: **Ralph J. Hall**, 161 Hoyle St.,
Marion, N.C. 28752
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[58] Field of Search **122/379, 390, 392**

[56] **References Cited**
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Primary Examiner—Kenneth W. Sprague
Attorney—Tom R. Vestal

[57] **ABSTRACT**
Method of cleaning soot particles from heat transfer surfaces in a boiler automatically and at predetermined intervals without the need of manual supervision.
5 Claims, 2 Drawing Figures

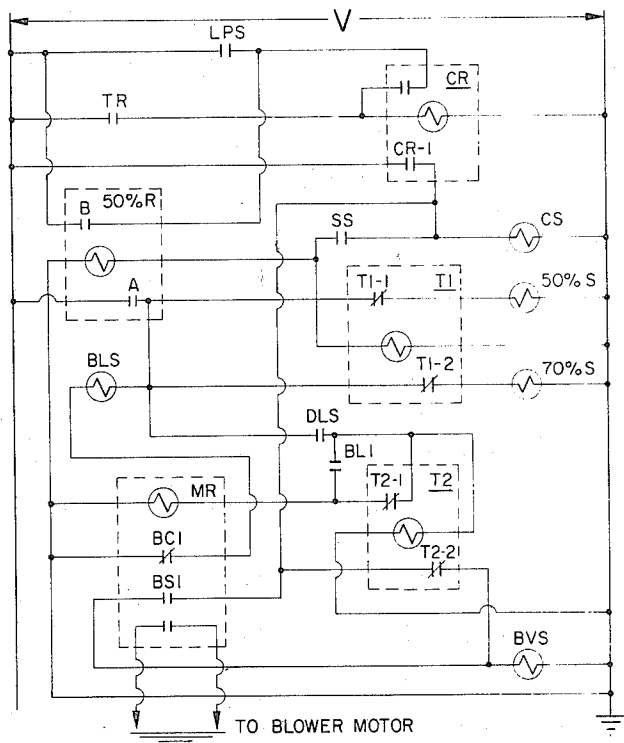


FIG. 1

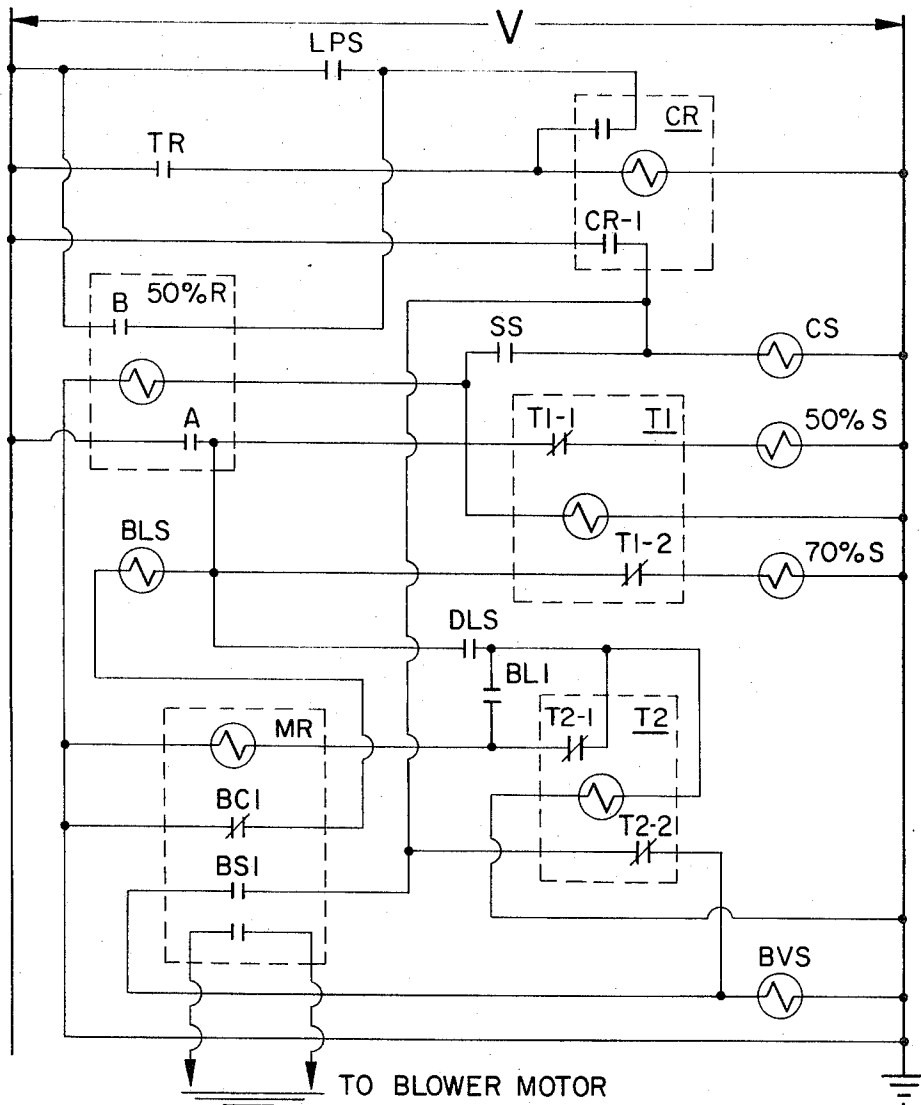
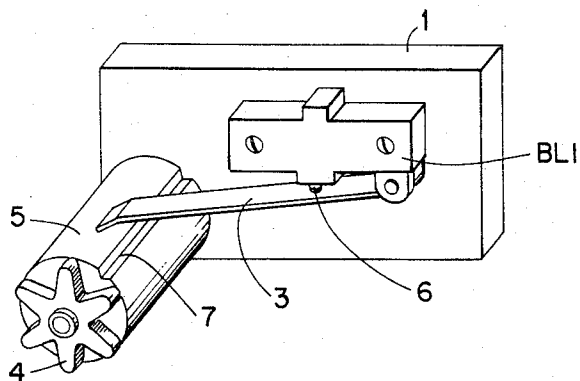


FIG. 2



SOOT CLEANING METHOD

It is well known that the combustion of most fossil fuels produces a solid residue called "ash." The finer portions of this ash residue has become generally known as "soot."

In the production of steam power utilizing these fossil fuels, this fine soot escapes from the boiler furnace and collects upon the heat transfer surfaces in the boiler flues. To maintain efficient operation of the boiler, i.e., heat transfer for steam producing purposes, it is required to remove the collected soot at periodic intervals. This removal is necessitated by the relatively low heat transfer characteristics of the soot. As the soot builds up, progressively more heat energy is required to produce the same amount of steam or hot water, with the unused heat escaping through the flues and ultimately to the atmosphere.

Soot removal in early days required complete shut-down of the boiler and hand cleaning. Later methods included introducing a cleaning fluid such as air or steam through a handhole in the boiler directed in such a manner, usually by hand, to remove the soot. One of the more common methods of late has been to fix a movable cleaning device within the boiler that removes soot during a cleaning cycle conducted periodically.

The late soot cleaning devices, commonly called soot blowers, have been "automated" to the extent that several may be operated in sequence with controls operative to insure the total units operating simultaneously do not draw too extensively on the steam producing capacity of the boiler.

In boiler units operating at or near capacity, operation of the soot blower causes minimal difficulty, other than a temporary reduction in steam making capacity due to the cooling effect of the soot blowing agent. Many boilers are operated on fluctuating steam demand cycles, however. If soot blowing is attempted when a boiler is operating in an instance of low steam demand, and the boiler firing rate is at a low level, the furnaces may be extinguished by its quenching effect. For this reason heretofore, soot blowing in variable demand situations has been a manual operation, or semi-automatic in that it required manual supervision to insure conditions that would not extinguish the boiler furnace.

The present invention is directed to a method of cleaning soot particles from heat transfer surfaces in a boiler at predetermined intervals without manual supervision. The present invention is further directed to a method of cleaning soot particles from heat transfer surfaces in a boiler subjected to variable load requirements without the need for manual supervision.

The present invention insures adequate firing during the soot cleaning process by automatically taking over the boiler firing rate process on a given signal from a common repetitive timing source. Upon the signal, the firing rate is reduced to allow steam pressure within the boiler to fall to a preselected level. This pressure level is based upon the anticipated energy buildup within the boiler with the boiler firing at a set firing rate, and is designed to achieve an adequate firing rate to prevent extinguishing the furnace fire during the soot cleaning cycle, yet not exceed the rate pressure capacity of the boiler vessel before the cycle is completed.

With reference to the drawings, the following example is illustrative of the method of the instant invention.

FIG. 1 is a schematic electrical diagram of the present invention.

FIG. 2 represents the indexing mechanism for controlling the soot cleaning cycle.

A boiler is firing at a variable load rate with a conventional pneumatic boiler control system. At a predetermined instant a control relay CR is energized through a timer relay TR. Through a normally open contact on CR, a solenoid actuated switch CS is actuated, bleeding the pneumatic control system and actuating a low pressure switch LPS. The low pressure switch LPS completes a parallel circuit with the timer relay TR, thereby locking the control relay CR until pressure is again returned to the pneumatic control system after completion of the cleaning cycle.

The bleeding of the pneumatic control system reduces the firing rate until the steam pressure has fallen to 126 lbs, whereupon steam line pressure switch SS is actuated, completing an electrical circuit through and energizing a timer switch T1 and relay switch 50 percent R. Timer switch T1 automatically resets after 2½ minutes. A pneumatic switch 50 percent S is actuated through a normally open, now closed contact A of relay 50 percent R and a normally closed, timed to open contact T1-1, thereby, pneumatically energizing the boiler firing controls with a preset pressure to set the boiler firing rate at 50 percent. When the boiler damper has opened to a 50 percent firing rate, limit switch DLS mounted by the damper is actuated providing a circuit through normally closed, timed to open contact T2-1 on a timer T2 to the soot blower starter motor coil MR, to start the blower motor. Timer T2 automatically resets after 15 seconds, but blower limit switch BL1 is activated by means to be further described after the soot blower has moved from its starting position, making a parallel circuit with timer contact T2-1 and maintaining a circuit through soot blower starter motor coil MR after timer T2 has reset.

Meanwhile, blower valve solenoid BVS has been energized through contact CR-1 on control relay CR and through normally closed timed to open contact T2-2. When soot blower starter motor coil MR is energized, normally open contact BS1 is closed, maintaining a circuit to BVS after timer T2 has reset. Simultaneously normally closed contact BC1 is opened, deenergizing a blower cam locking switch BLS, and thus allowing the locking open of a blower cam arm (not shown) that normally would close the soot blower valve mechanism at its starting position.

When the soot blower has made three revolutions, index switch BL1 is opened by means to be described later, thereby deenergizing blower motor starter coil MR and blower valve solenoid BVS through now opened contact BS1 and unlocking of the blower cam arm.

If the steam pressure has not risen to 148 pounds per square inch at the end of the two and one-half minute cycle of timer relay T1, contact T1-1 is opened and contact T1-2 is closed, thereby energizing pneumatic switch solenoid 70 percent S, which functions to increase the firing rate of the boiler to 70 percent. When 148 pounds has been attained, steam switch SS is opened, thereby deenergizing relay 50 percent R and opening contact B on 50 percent R. Open contact B deenergizes control relay CR, opening contact CR-1 and deenergizing solenoid valve CS, repressuring the boiler controls and returning the boiler system to normal.

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In FIG. 2, a switch mounting 1 is located adjacent the geared shaft of the blower motor (not shown). The blower motor gear shaft rotates once for each revolution of the soot blower within the boiler housing. The toothed gear 4 is rotatably mounted on switch mounting 1 and intermeshes with a corresponding gear on the blower motor gear shaft (not shown) so that toothed gear 4 rotates once for each three times the blower motor shaft rotates. Cam 5 is rotatably attached to switch mounting 1, whose rotation corresponds to toothed gear 4. Switch arm 3 is maintained in contact with actuator button 6 of index switch BL1 through contact with cam 5. A notch 7 in cam 5 allows switch arm 3 to drop contact with actuator button 6 once for each revolution of said cam 5, thereby opening index switch BL1.

It is recognized that the above pressures and timing sequences are representative and may be changed according to the invention herein to correspond to similar boiler systems.

I claim:

1. In an automatic boiler system, a method for cleaning soot from heat transfer surfaces, including:
 - a. reducing the firing rate of the boiler until a preselected lower pressure is attained;
 - b. increasing the firing rate to a first constant level; and
 - c. activating the soot blowing mechanism for a se-

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lected time interval adequate to remove soot from the boiler transfer surfaces, the constant level firing rate being sufficient to maintain the steam pressure below a preselected maximum.

2. The method of claim 1, including inactivating the normal boiler firing rate controls when the preselected lower pressure is attained.

3. The method of claim 1, including increasing the steam pressure until the preselected maximum has been attained after completion of the soot cleaning cycle, activating a switching mechanism to return the boiler system to a normal cycle.

4. The method of claim 1, including increasing the firing rate to a second constant level after the firing cycle has been completed until the preselected maximum pressure has been attained.

5. In a boiler system having a variable steam demand, a method for controlling the firing rate of the boiler system during a soot cleaning cycle, comprising: reducing the firing rate in the boiler system until a preselected lower pressure is attained; and inactivating the normal boiler system firing controls and firing the boiler at a first constant rate sufficient to both prevent extinguishing of the boiler furnace and maintain the steam pressure below a preselected upper pressure during the soot cleaning cycle.

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