

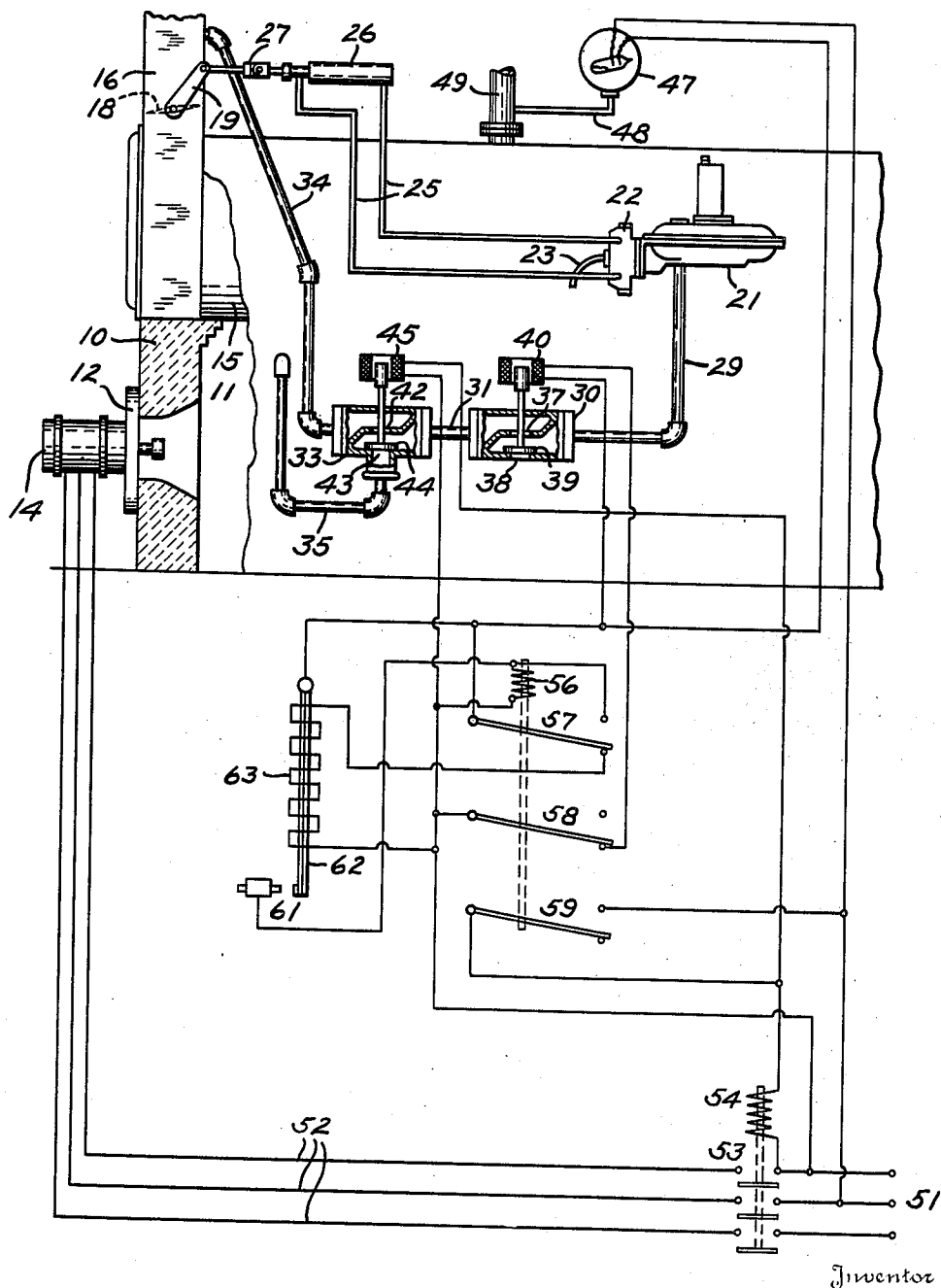
Aug. 10, 1943.

J. J. KLINKER

2,326,230

FURNACE REGULATION

Filed Sept. 10, 1941



JOHN J. KLINKER

By

Albert L. Blodgett  
Attorney

## UNITED STATES PATENT OFFICE

2,326,230

## FURNACE REGULATION

John J. Klinker, Decatur, Ill., assignor to A. W. Cash Company, Decatur, Ill., a corporation of Delaware

Application September 10, 1941, Serial No. 410,279

6 Claims. (Cl. 236—14)

This invention relates to furnace regulation, and more particularly to the regulation of furnaces which are started and stopped automatically in accordance with the demand for heat.

In connection with start and stop furnaces it is a common practice to place the uptake damper in a fixed position of adjustment. This is an uneconomical procedure. When the furnace is operating, changes in the furnace draft will occur and this will vary the fuel-air ratio, resulting in inefficient combustion. When the furnace is stopped, air will continue to flow therethrough by natural draft, so that the furnace and boiler will be rapidly cooled.

It is accordingly one object of the invention to provide a simple apparatus whereby the flow of air through a furnace will be prevented automatically when the furnace is stopped.

It is a further object of the invention to provide an improved apparatus for controlling the uptake damper in a furnace fired by a natural draft oil burner of the full automatic type, whereby efficient combustion will be obtained and air flow through the furnace during the shut-down periods will be prevented.

With these and other objects in view, as will be apparent to those skilled in the art, the invention resides in the combination of parts set forth in the specification and covered by the claims appended hereto.

Referring to the drawing illustrating one embodiment of the invention, and in which like reference numerals indicate like parts, the single figure is a diagrammatic elevation, partly in section, of a steam boiler furnace and certain automatic control apparatus.

The embodiment illustrated comprises walls 10 forming a furnace combustion chamber 11 fired by a natural draft oil burner 12 of the full automatic type having the usual electric motor 14. It will be understood that when the motor is started, it will actuate a pump (not shown) to force a spray of oil into the chamber 11, this oil being ignited by suitable means (such as a spark device) forming a part of the burner installation. The heat from the furnace 11 is utilized to generate steam in a boiler 15 mounted thereabove. The furnace gases flow in contact with the boiler heating surfaces and then escape through a gas outlet duct or uptake 16 leading to a suitable stack (not shown). The outlet duct 16 is provided with an adjustable damper 18 having an operating arm 19. The stack will produce a substantial draft or sub-atmospheric pressure in the duct 16, and

when the damper 18 is open this will produce a flow of air inwardly through the burner 12 to support the combustion of the fuel in the furnace 11.

5 The damper 18 is controlled automatically by a suitable regulator to maintain a predetermined draft in the furnace 11 while the burner 12 is in operation. Thus a constant supply of combustion air will be ensured regardless of variations in the stack draft. For this purpose I preferably utilize an automatic regulator 21 of the type disclosed in the patent to Temple No. 1,992,048 granted February 19, 1935. This regulator comprises a pilot valve mechanism 22 supplied with a suitable fluid under pressure through a pipe 23 and connected by tubes 25 to a hydraulic motor 26. This motor is connected to the damper operating arm 19 by means of a rod 27. The regulator 21 is adjusted for a desired predetermined furnace draft, appreciably below atmospheric pressure and sufficient to ensure a desired supply of air for combustion of the fuel while the burner is in operation.

During the shut-down periods it is desirable to close the damper 18 and thereby prevent air flow through the furnace and boiler. I preferably accomplish this by subjecting the regulator 21 to a pressure below that for which it is adjusted. Also it is desirable to open the damper 18 fully just prior to each starting of the burner motor 14, so that there will be no lack of draft and possibility of flare-backs when ignition occurs. In my preferred construction this is brought about by subjecting the regulator 21 for a brief period to a pressure above that for which it is adjusted. As illustrated, the regulator is connected by a pipe 29 to a three-way solenoid valve 30 which in turn is connected by a pipe 31 to a second three-way solenoid valve 33. This second valve 33 is connected by a pipe 34 to the duct 16 at a point beyond the damper 18, and by a pipe 35 to the furnace chamber 11. The valve 30 is provided with two aligned ports 37 and 38 between which there is mounted a reciprocable valve member 39 controlled by a solenoid 40. When this solenoid is energized the valve member 39 will close the port 37, and when the solenoid is deenergized the valve member will close the port 38. The port 31 connects the pipe 29 with the pipe 31, while the port 38 connects the pipe 29 with the atmosphere. The valve 33 is provided with two aligned ports 42 and 43 between which there is mounted a reciprocable valve member 44 controlled by a solenoid 45. When this solenoid is energized the valve

member 44 will close the port 42, and when the solenoid is deenergized the valve member will close the port 43. The port 42 connects the pipe 31 with the pipe 34, while the port 43 connects the pipe 31 with the pipe 35. With this construction and both solenoids deenergized, the regulator will be connected with the outlet duct 16, and the damper 18 will be closed as illustrated. If the solenoid 40 is energized, the regulator will be connected to atmosphere, and the damper 18 will be opened wide. If the solenoid 45 is energized and the solenoid 40 deenergized, the regulator will be connected to the furnace chamber 11, and the damper 18 will be controlled to maintain the desired furnace draft.

The burner motor 14 is started and stopped automatically in accordance with the demand for heat. For this purpose I have shown a pressure-actuated master switch 47 of the well-known mercury tube type connected by a pipe 48 to the steam delivery pipe 49 of the boiler 15, and arranged to close at a predetermined minimum steam pressure and to open at a predetermined maximum steam pressure. The motor 14 is connected to a suitable electrical supply 51 by means of conductors 52 which lead through an electromagnetically actuated switch 53. This switch is provided with a coil 54, and the parts are so arranged that upon energization of this coil the switch will be closed and the motor 14 will start.

In order to control the operation of the various parts in a desired manner, I prefer to utilize a time delay relay comprising a coil 56 arranged to actuate three switches 57, 58 and 59. The switch 57 is of the double throw type, the switch 58 is normally closed, and the switch 59 is normally open. The relay further comprises a normally open thermostatically actuated switch 61 having a bimetal strip 62 and a heating coil 63. The electrical supply 51 is shown as three-phase, and in the illustrated embodiment one phase of this supply is utilized for energization of the several coils and solenoids, but it will be apparent that an entirely separate power source may be employed if desired. It will be noted that the master switch 47, the thermostatic switch 61 and the coil 56 are connected in series. Also, the master switch 47, the switch 58 and the solenoid 40 are connected in series. The switch 57 normally connects the master switch 47 in series with the heating coil 63, but when the switch 57 is raised it shunts the thermostatic switch 61. The solenoid 45 and the coil 54 are connected in parallel, and both are controlled by the switch 59.

The operation of the invention will be apparent from the above disclosure. Assuming that the steam pressure is sufficiently high, the various parts will be positioned as illustrated. The master switch 47 will be open, all the coils and solenoids will be deenergized, the switch 53 will be open, and the burner 12 will be shut down. The regulator 21 will be connected to the outlet duct 16, and since the pressure in this duct is lower than that for which the regulator is adjusted, the regulator will be unbalanced in such a direction as to hold the damper 18 closed. Thus wasteful flow of cool air through the furnace and boiler will be prevented. If now the steam pressure should drop sufficiently to close the master switch 47, the heating coil 63 and the solenoid 40 will both be energized. This will start the heating of the bimetal strip 62 and at the same time the atmospheric vent 38 will be opened. Thus the regulator 21 will be subjected to a pressure

greater than that for which it is adjusted, and it will accordingly be unbalanced in the opposite direction and start to open the damper 18. After a brief interval sufficient for the damper to reach its open or nearly open position, the bimetal strip will become hot enough to close the switch 61 and energize the coil 56. This will raise the switches 57, 58 and 59, deenergizing the coil 63 and solenoid 40, and energizing the coil 54 and solenoid 45. The switch 57 will shunt the switch 61 and thus maintain energization of the coil 56 despite the cooling of the bimetal strip 62. The switch 53 will be closed, starting the burner motor 14, and the combustion of the fuel will begin. Since the damper 18 is open, no flare-backs will occur. The valve ports 43 and 37 will be opened, connecting the regulator 21 with the furnace 11, and the regulator will thereupon control the damper 18 in such a way as to maintain a predetermined furnace draft and ensure a predetermined fuel-air ratio. As the steam pressure once more reaches the point required to open the master switch 47, the coil 56 will be deenergized, the switch 59 will open, deenergizing the coil 54 and the solenoid 45. The switch 53 will open, stopping the burner motor 14. The regulator 21 will again be connected to the outlet duct 16, and the damper 18 will be closed once more to prevent air flow through the furnace and boiler.

It will be recognized that many changes and variations may be made in the construction and arrangement of the various parts without departing from the spirit of the invention, and therefore it is intended to include all such changes and variations within the scope of the following claims.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

1. A control system for a furnace having fuel supply means, a duct for the discharge of the gaseous products of combustion from the furnace, and a damper in the duct comprising means to start and stop the fuel supply means in accordance with the demand for heat, a regulator arranged to control the damper and responsive to the furnace pressure while the fuel supply means is operating, the regulator being adjusted for a predetermined sub-atmospheric pressure, and means to subject the regulator to the pressure in the duct beyond the damper when the fuel supply means is stopped and thus cause the regulator to close the damper.

2. A control system for a furnace having fuel supply means and a damper to control the discharge of the gaseous products of combustion from the furnace comprising means to start and stop the fuel supply means in accordance with the demand for heat, a regulator arranged to control the damper and responsive to the furnace pressure while the fuel supply means is operating, the regulator being adjusted for a predetermined sub-atmospheric pressure, means to subject the regulator to a higher pressure for a short time just prior to each starting of the fuel supply means and thus cause the regulator to open the damper, and means to subject the regulator to a lower pressure when the fuel supply means is stopped and thus cause the regulator to close the damper.

3. A control system for a furnace having fuel supply means, a duct for the discharge of the gaseous products of combustion from the furnace, and a damper in the duct comprising means to start and stop the fuel supply means

in accordance with the demand for heat, a regulator arranged to control the damper and responsive to the furnace pressure while the fuel supply means is operating, the regulator being adjusted for a predetermined sub-atmospheric pressure, means to subject the regulator to atmospheric pressure for a short time just prior to each starting of the fuel supply means and thus cause the regulator to open the damper, and means to subject the regulator to the pressure in the duct beyond the damper when the fuel supply means is stopped and thus cause the regulator to close the damper.

4. A control system for a furnace having fuel supply means, a duct for the discharge of the gaseous products of combustion from the furnace, and a damper in the duct comprising a regulator arranged to control the damper and adjusted for a predetermined sub-atmospheric pressure, a time-delay relay, means to initiate operation of the relay and to subject the regulator to atmospheric pressure in response to a demand for heat, means responsive to completion of the relay operation to start operation of the fuel supply means and to subject the regulator to the furnace pressure, and means responsive to lack of demand for heat to stop operation of the fuel supply means and to subject the regulator to the pressure in the duct beyond the damper.

5. A control system for a furnace having fuel supply means, a duct for the discharge of the gaseous products of combustion from the furnace, and a damper in the duct comprising a regulator arranged to control the damper and adjusted for a predetermined sub-atmospheric pressure, valve mechanism whereby the regulator may be connected selectively to the furnace, to the atmosphere or to the duct beyond

the damper, a time delay relay, means to initiate operation of the relay and actuate the valve mechanism to connect the regulator to the atmosphere in response to a demand for heat, means responsive to the completion of the relay operation to start operation of the fuel supply means and actuate the valve mechanism to connect the regulator to the furnace, and means responsive to lack of demand for heat to stop operation of the fuel supply means and actuate the valve mechanism to connect the regulator to the duct beyond the damper.

6. A control system for a furnace having fuel supply means, a duct for the discharge of the gaseous products of combustion from the furnace, and a damper in the duct comprising a regulator arranged to control the damper and adjusted for a predetermined sub-atmospheric pressure, two solenoid operated three-way valves, the first valve being operable to connect the regulator selectively to either the atmosphere or the second valve, and the second valve being operable to connect the first valve to either the furnace or the duct beyond the damper, a time delay relay, means responsive to a demand for heat to initiate operation of the relay and actuate the first valve to connect the regulator to the atmosphere, means responsive to the completion of the relay operation to start operation of the fuel supply means, actuate the first valve to connect the regulator with the second valve, and actuate the second valve to connect the first valve with the furnace, and means responsive to lack of demand for heat to stop operation of the fuel supply means and actuate the second valve to connect the first valve with the duct beyond the damper.

JOHN J. KLINKER.