Feb. 9, 1932. W. F. TROTTER 1,844,615

STOKER CONTROL

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FIG. 1

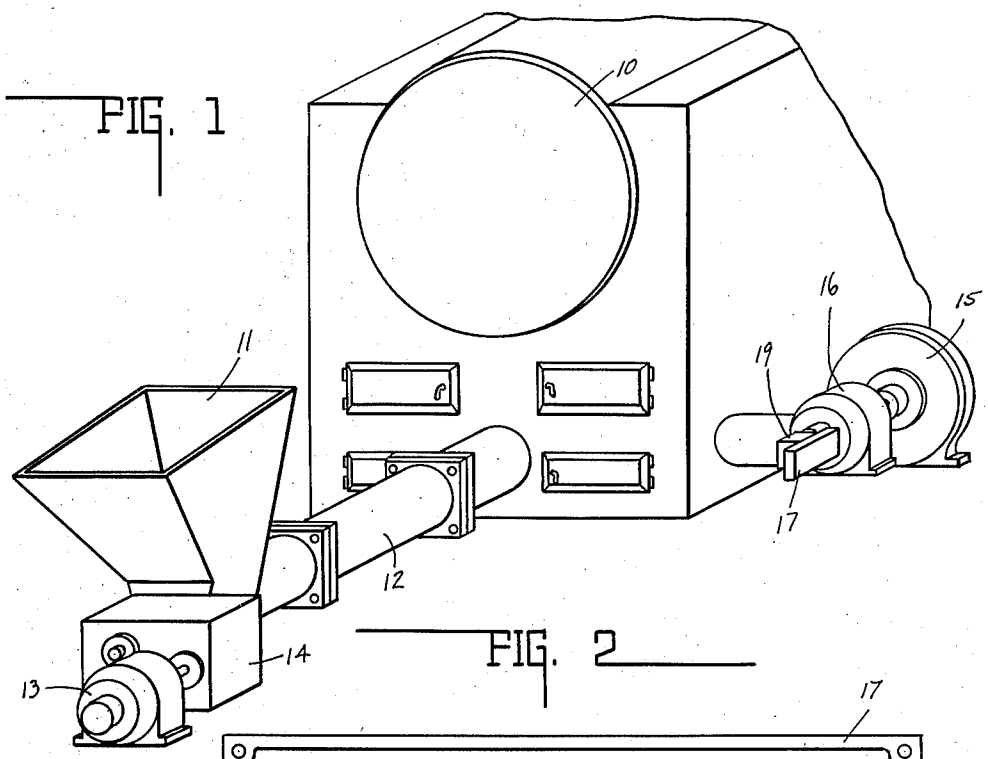


FIG. 2

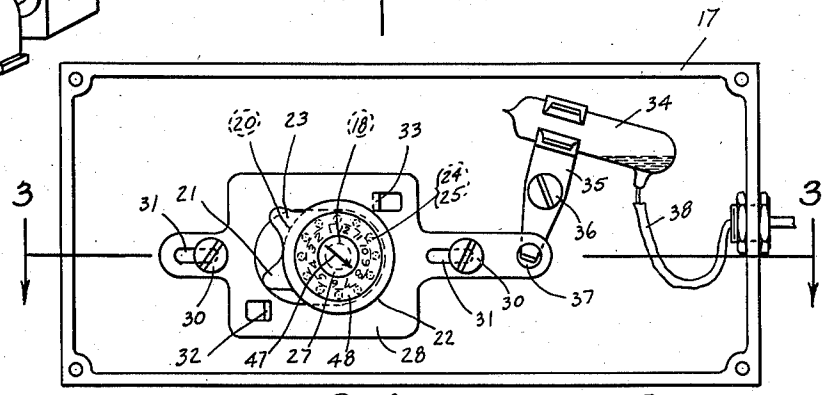
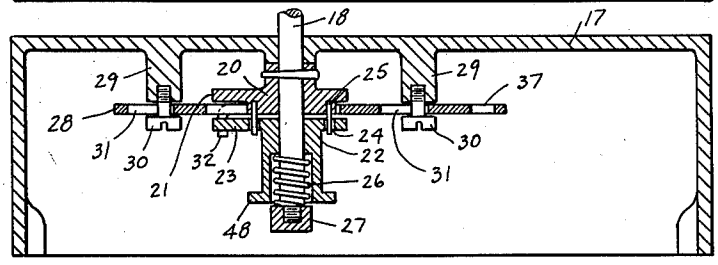


FIG. 3



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FIG. 4

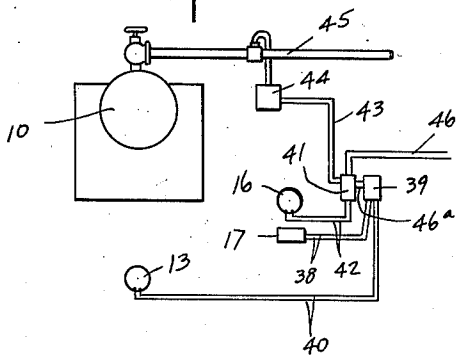


FIG. 5

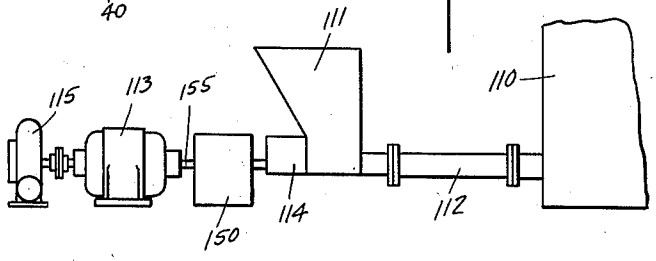
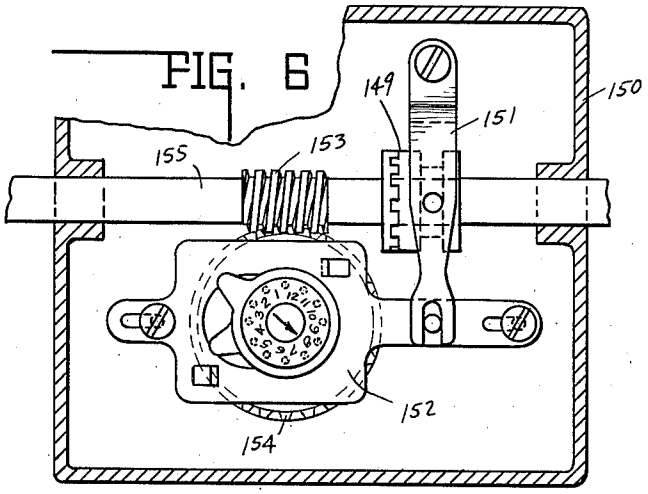


FIG. 6



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STOKER CONTROL

Application filed January 9, 1931. Serial No. 507,565.

This invention relates to a method and apparatus for combustion control. The invention is particularly applicable to stoker-fired furnaces, but is also useful in other types of combustion apparatus wherein the fuel is mechanically supplied.

The principal object of the invention is to provide a method and apparatus for properly proportioning the amount of fuel supplied and the amount of air supplied by artificial draft for combustion purposes. Heretofore it has been the practice, in installations wherein a mechanical stoker and an artificial draft are intermittently operated, to operate the stoker and the draft fan simultaneously and for equal periods of time. By that method, draft is supplied only during the time that fuel is fed to the furnace. As soon as the feeding of fuel stops, the supply of artificial draft is also stopped. Unless the rate of fuel supply and rate of air supply are accurately adjusted for a given fuel, an amount of unburned fuel will be present in the furnace when the draft supply is cut off. Since different fuels require different lengths of time and different amounts of air for their burning, such an arrangement, even when accurately adjusted, is only efficient for one type of fuel unless the rate of fuel supply or air supply may be adjusted with the change of fuel.

The principal feature of the present invention consists in the provision of a method and means for proportioning the length of time of fuel feed and the length of time of draft supply rather than proportioning the rates thereof. The stoker is preferably operated for a shorter length of time for each operation than the fan and the driving mechanisms for the fan and stoker are interconnected in such manner that the stoker is operated a predetermined percentage of the time of the fan operation. Means are provided for conveniently varying this predetermined percentage of time so that the proper proportion of fuel and air is easily obtained for the particular grade of fuel being used.

Other objects and features and the full nature of the invention will be understood from the accompanying drawings and the following description and claims:

Figure 1 is a perspective view of a boiler having a furnace, a stoker and a forced draft fan. In this form of the apparatus, the fan and stoker are driven from separate power sources. Figure 2 is an elevational view of the apparatus used for proportioning the time of operation of the stoker and fan. Figure 3 is a sectional view taken on the line 3—3 of Figure 2. Figure 4 is a diagram of the control apparatus used in applying the invention to a boiler to maintain a uniform boiler pressure. Figure 5 is a diagrammatic representation of the apparatus wherein a single power source is used for both the stoker and fan. Figure 6 is an elevational view of the apparatus used for proportioning the time of stoker and fan operation with the arrangement shown in Figure 5.

In the drawings there is shown a boiler 10 fitted with a fuel hopper 11 from which fuel is supplied through a stoker housing 12 to the furnace of the boiler. The housing 12 contains any suitable form of feeding mechanism driven by a motor 13 through reduction gears contained in a gear box 14. Forced draft is supplied to the furnace by means of a fan 15 driven by a motor 16. A switch box 17 is mounted upon the motor 16 and contains a shaft 18 driven from the motor shaft by suitable gears contained in a gear box 19.

The shaft 18 extends within the switch box 17 and has fastened thereto a cam 20 having a projection 21 formed thereon. A cam 22 having a projection 23 is also carried upon the shaft 18 but is free for both longitudinal and rotational movement with respect thereto. The cam 22 is fitted with openings 24 engaging pins 25 carried by the cam 20. When the said pins and openings are engaged, therefore, the cams 20 and 22 rotate in unison with the shaft 18. The engagement of the said pins and openings is maintained by a spring 26 carried within the hub of cam 22 and abutting against a collar 27 threadedly fastened upon the end of the shaft 18. By this means, the cam 22 may be manually drawn backward upon the shaft 18 and rotated to bring the pins 25 into engagement with the open-

ings 24 in such manner as to place the projections 21 and 23 in any desired angular relation with respect to each other. A slide 28 is supported upon bosses 29 by means of screws 30 engaging longitudinal openings 31 in the said slide. As will be seen from Figure 3, the slide 28 is so placed as to have the projection 21 upon one side and the projection 23 upon the opposite side thereof. Upon one side of the slide 28 there is formed a projection 32 adapted to be engaged by the projection 23. Upon the opposite side is formed a projection 33 positioned to be engaged by the projection 21. By this means the rotation of shaft 18 moves the slide to the left in Figure 2 when projection 23 engages projection 32 and returns the said slide to the right when projection 21 engages projection 33. Since the projections 21 and 23 may be set at any desired angular relation, the slide 28 may be maintained in the left hand or right hand position any desired percentage of the time of rotation of shaft 18.

A mercury switch 34 is carried upon a lever 35 pivotally mounted by means of a screw 36 within the switch box 17. The opposite end of the lever 35 engages an opening 37 in the slide 28. By this means the movements of the said slide to right and left alternately tilt the mercury switch 34 into open-circuit and closed-circuit positions. The mercury switch 34 has connected thereto electrical connections 38 leading to a motor controller 39 adapted to start and stop the motor 13 by means of electrical connections 40. These electrical connections and the motor controller are such that the motor 13 may be operated only when the mercury switch 34 is in closed-circuit position.

In the form of apparatus shown in Figure 4, the fan motor 16 is controlled by a controller 41 connected thereto by conductors 42. The controller 41 is connected by conductors 43 with a pressure-operated switch 44 of any well known form which is adapted to close and open its circuit in response to pressure changes in a steam pipe 45 leading from the boiler 10. The adjustment of the switch 44 is such that its circuit is closed when the pressure in pipe 45 is below the boiler pressure it is desired to carry. The said circuit is opened when the boiler pressure is above this desired pressure. Conductors 46 supply power to controller 39 from any suitable power source. Power is in turn supplied from controller 41 to controller 39 by conductors 46*a* only when controller 41 is actuated by the closing of the circuit in switch 44 so that the stoker motor 13 can operate only during operation of the fan motor 16. By this means the fan motor 16 is operated only when it is necessary to increase the furnace temperature to bring the boiler pressure up to normal. The stoker motor 13 and the stoker are operated only during a predetermined percentage of the time of operation of the fan motor 16 and are stopped during the remainder of fan motor operation and when the fan motor is not in operation. This predetermined percentage of time is determined by the angular position of the projections 21 and 23 in the switch box 17. This angular position is indicated by an index arrow 47 marked upon the collar 27 and registering with index numbers 1 to 12 carried upon a flange 48 formed upon the hub of cam 22. For example, if it is desired to run the stoker fifty percent of the time of fan operation, or six minutes out of every twelve minutes of the fan operation, the arrow 47 is set to the index number 6. The mercury switch 34 will then be moved to closed-circuit position six minutes out of every twelve minutes of fan operation.

In the form of apparatus shown in Figure 5, a boiler 110 receives fuel from a fuel hopper 111 through stoker housing 112. A motor 113 drives the said stoker through a clutch 149 in a housing 150 and suitable gears in a gear box 114. The clutch 149 may be thrown into operative and inoperative positions by a lever 151 controlled by a mechanism 152 similar in all important respects to the mechanism previously described for controlling the mercury switch 34. This mechanism 152 is driven by a worm 153 and a worm wheel 154, the said worm being mounted upon the motor shaft 155 driven by the motor 113. The motor 113 is directly connected to a fan 115 which supplies forced draft to the boiler through conduits not shown. In the operation of this form of the apparatus, the motor 113 may be controlled in the same manner as the motor 16 in the previous form,—that is, it operates only when an increase of furnace temperature is required. The mechanism 152 operates the clutch 149 to drive the stoker a desired percentage of the time of operation of the motor 113. It is to be noted that while the mechanism 152 is of the same general form as that for operating the mercury switch 34, the parts must be of heavier construction because of the heavier duty required thereof.

In the operation of the method and apparatus herein described a larger quantity of fuel is fed to the furnace at each stoker operation than is immediately required. After the feeding of fuel ceases, the fan continues to operate as long as an increase of furnace temperature is required. If this period is longer than that required for one complete revolution of shaft 18, another period of fuel feeding is initiated. If the heating requirements do not require the operation of stoker and fan, such operation ceases and is again taken up at the point of cessation when heating requirements again increase.

While the foregoing specifications describe the invention as applied to a boiler in such manner as to maintain a predetermined boiler

pressure, it is evident that it can also be applied to heaters for other purposes. As applied to a heater, a thermostatic switch is substituted for the pressure-operated switch 44. The said switch then operates the apparatus to maintain a predetermined temperature rather than a predetermined pressure.

The invention claimed is:

1. Combustion control apparatus for a furnace including intermittently operable draft apparatus adapted to supply draft at a substantially constant rate when operating to said furnace, a stoker adapted to supply fuel to said furnace, means for intermittently operating said draft apparatus in automatic response to heating requirements, a source of power for said stoker, and means for connecting said power source and said stoker for supplying fuel, said means being automatically operable a predetermined percentage of the time of operation of said draft apparatus.

2. Combustion control apparatus for a furnace including intermittently operable draft apparatus adapted to supply draft to said furnace at a substantially constant rate when operating, a stoker adapted to supply fuel to said furnace, mechanism for automatically starting said draft apparatus in response to a requirement for increased furnace temperature and for automatically stopping the same when said increased furnace temperature is no longer required, a source of power for said stoker, and means for connecting said power source and said stoker for supplying fuel, said means being automatically operable a predetermined percentage of the time of operation of said draft apparatus.

3. Combustion control apparatus for a boiler furnace including intermittently operable draft apparatus adapted to supply draft to said furnace at a substantially constant rate when operating, a stoker adapted to supply fuel to said furnace, control mechanism for intermittently operating said draft apparatus in automatic response to variations in boiler pressure. a source of power for said stoker, and means for connecting said power source and said stoker for supplying fuel, said means being automatically operable a predetermined percentage of the time of operation of said draft apparatus.

4. Combustion control apparatus for a furnace including intermittently operable draft apparatus adapted to supply draft to said furnace at a substantially constant rate when operating, a stoker adapted to supply fuel to said furnace, a motor for driving said draft apparatus, a second motor for driving said stoker, regulating means for intermittently operating said draft motor in automatic response to furnace heating requirements, control means for stopping and starting said stoker motor, and mechanism driven by said draft motor and adapted to actuate said control means to operate said stoker motor a predetermined percentage of the time of operation of said draft motor.

5. Combustion control apparatus for a furnace including intermittently operable draft apparatus adapted to supply draft to said furnace at a substantially constant rate while operating, a stoker adapted to supply fuel to said furnace, a motor for driving said draft apparatus and stoker, said motor being permanently connected to said draft apparatus, a clutch for intermittently connecting said motor and said stoker, regulating means for intermittently operating said motor in automatic response to furnace heating requirements, and mechanism driven by said motor and adapted to actuate said clutch a predetermined percentage of the time of operation of said motor.

6. A method of combustion control for stoker-fired furnaces including intermittently supplying draft at a substantially constant rate in automatic response to heating requirements, and automatically operating the stoker to supply fuel a predetermined percentage of the time during which said draft is supplied.

7. A method of combustion control for stoker-fired boilers including intermittently supplying draft at a substantially constant rate in automatic response to variations in boiler pressure, and automatically operating a stoker to supply fuel a predetermined percentage of the time during which said draft is supplied.

In witness whereof, I have hereunto affixed my signature.

WALTER F. TROTTER.