

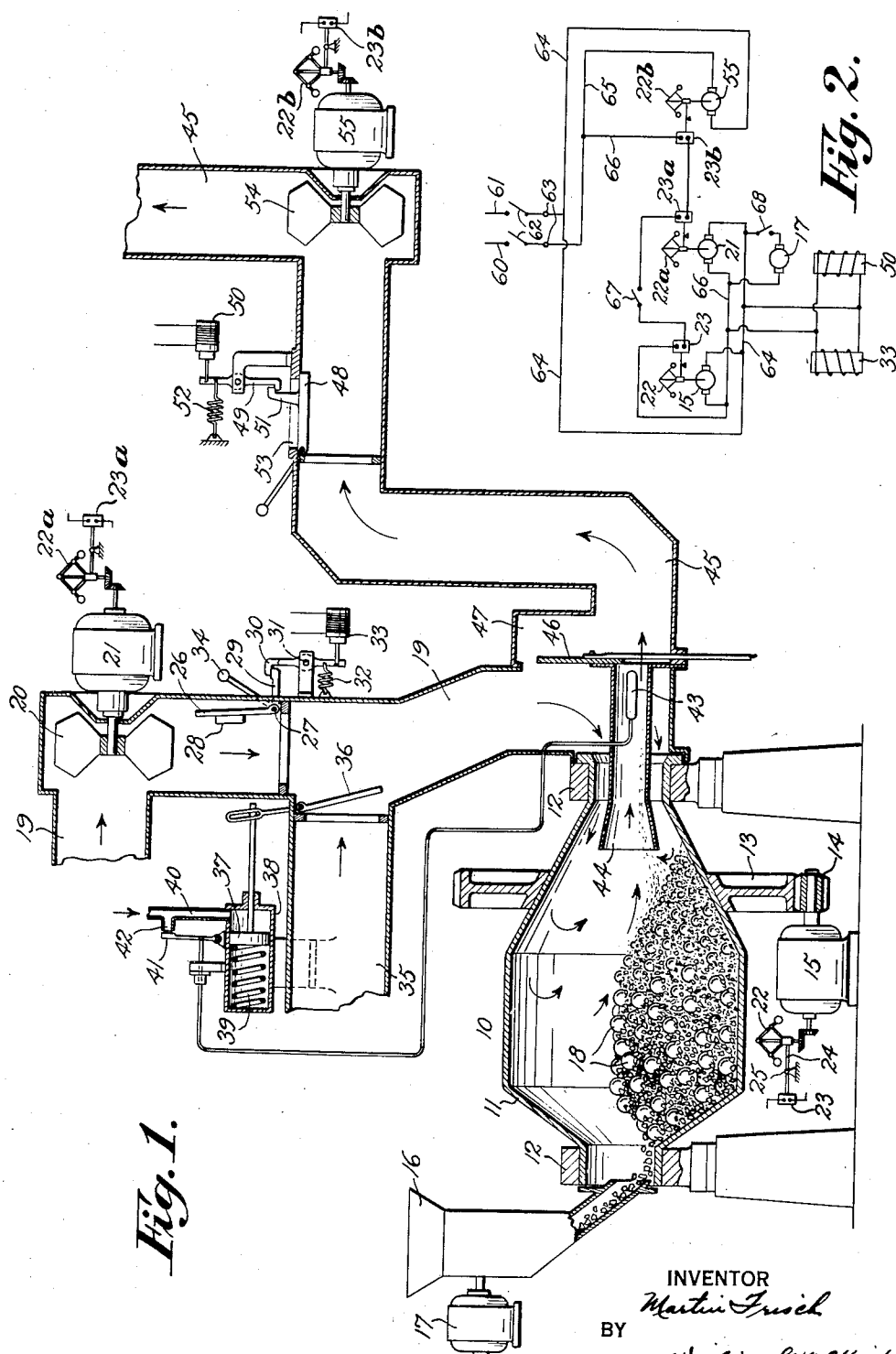
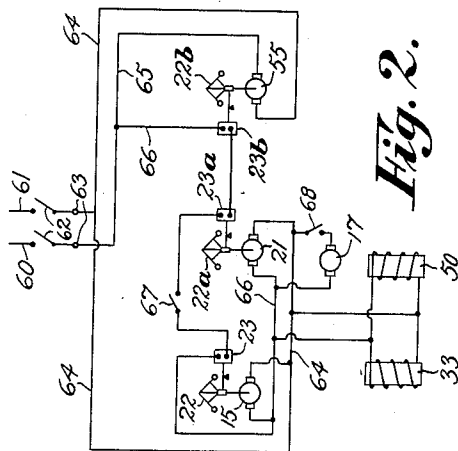
Feb. 21, 1933.

M. FRISCH

1,898,086

PULVERIZING APPARATUS

Filed June 12, 1930



INVENTOR
Martin Trisch
BY
William G. W. Knight
his ATTORNEY

UNITED STATES PATENT OFFICE

MARTIN FRISCH, OF BRONX, NEW YORK, ASSIGNOR TO FOSTER WHEELER CORPORATION, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK

PULVERIZING APPARATUS

Application filed June 12, 1930. Serial No. 460,596.

My invention relates to combustion control and more particularly to control mechanism for plants wherein a mixture of pulverized coal and air is produced for combustion in the furnace of a steam generator or the like, the proportion of pulverized coal and air being regulated for proper combustion. Such a mixture may be explosive and, in the event of flame propagation back from the combustion chamber or burner, the coal dust in the conduit leading to the burner or in the pulverizing mill is likely to explode with disastrous results. Such flame propagation is apt to occur due to a reduction in the supply of pulverized coal and air to the furnace caused by a failure of the fan utilized to promote the conveyance of coal dust and air to the burner. Such flame propagation may also result from shutting down the pulverizer while the drum is partially full of coal, as may become necessary upon a failure of a boiler tube or some other cause requiring that the combustion flame be extinguished immediately.

Among the objects of my invention is to provide a safety system which will prevent the propagation of flame back to the pulverizer or back into the conduit system in the event that the air draft from the pulverizer to the burner fails, either on account of a failure of the fan motor or because of the necessity for suddenly stopping the pulverizer while the drum is partially full of coal. My invention further provides for the operation of a safety system in the event that any of the motors used in the operation of the mill stop for any reason whatsoever and even though the supply of electric current to their terminals has not failed.

Further objects and advantages of my invention will be apparent from the following description taken in connection with the accompanying drawing, which is to be considered a part of this specification and on which: Fig. 1 is a more or less diagrammatic cross-sectional view of my safety system applied to a ball mill pulverizer; and

Fig. 2 is a wiring diagram showing electric circuits used in connection with the apparatus shown in Fig. 1.

Referring more particularly to Fig. 1, reference character 10 designates generally a rotary mill of the loose ball type for pulverizing coal. The mill comprises a drum 11 having conically shaped ends, rotatably mounted in bearings 12. Drum 11 is provided with a gear 13 which engages a pinion 14 mounted on the shaft of a mill motor 15. Motor 15 is provided with a speed governor 22 (see also Fig. 2) of any suitable type which actuates an electric switch 23 through the medium of an arm 24 pivoted at 25. The arrangement of the governor and switch is such that the switch is held closed as long as the governor is rotated at a predetermined speed but as soon as the speed decreases below a predetermined abnormally low value the governor opens the switch. The switch also comprises suitable well-known means, not shown, whereby the circuit therethrough may be manually held closed temporarily in order to permit the motor and governor to come up to speed during initial starting or after a shut down, whereafter the governor maintains the switch closed as long as the speed does not drop below the predetermined low value. A hopper 16 is provided internally with a feed mechanism of any known type driven by an electric motor 17 or otherwise, as from the drum 11, and supplies lumps of coal to one end of drum 11. A number of steel crushing or grinding balls 18 of varying size are contained within drum 11.

A conduit 19 leads from an air preheater or other source of air or gas and is provided with a forced draft fan 20 actuated by an electric motor 21. Motor 21 is provided with a governor 22a arranged to actuate a switch 23a in a manner similar to that described in connection with mill motor 15.

Conduit 19 below fan 20 is provided with a quick closing damper 26. The damper is pivoted at 27 and is provided with an offset weight 28 which insures that the damper will fall to closing position upon being released. An arm 29 is rigidly attached to the damper and extends outside of conduit 19 where it may be engaged by a latch 30 pivoted at 31. A spring 32 tends to hold latch 30 out of engagement with arm 29 while a solenoid 33

acts counter to spring 32 and hence tends to engage latch 30 with arm 29. When the solenoid is energized it exerts sufficient force to overcome spring 32. A reset handle 34 is attached to damper 26 for the purpose of opening the damper by hand.

A conduit 35 communicates with conduit 19 at a point below damper 26 and leads from any suitable source of fresh air. Flow through conduit 35 is regulated by damper 36 which is actuated by a piston 37 in a cylinder 38. A spring 39 tends to move piston 37 so as to close damper 36 while a fluid such as compressed air from any suitable source, admitted to the cylinder through a conduit 40 tends to move the piston in the opposite direction. The pressure of the air supplied to cylinder 38 through conduit 40 is regulated by means of a valve member 41 controlling a vent 42 in conduit 40. Valve member 41 is actuated by a thermostatic element 43 so as to close vent 42 more or less upon an increase of temperature in the vicinity of the thermostatic element.

Conduit 19 extends from its point of communication with conduit 35 to the end of drum 11 opposite the end at which coal is introduced. A fuel discharge pipe 44 extends within drum 11 and communicates with a discharge conduit 45. Thermostatic element 43 is placed in pipe 44 and hence is affected by the temperature at this point. A dual valve 46 regulates the cross-sectional area of flow from pipe 44 into conduit 45 and at the same time regulates flow through a by-pass 47 from conduit 19 to conduit 45 so as to increase one while decreasing the other and vice versa.

Conduit 45 leading to the combustion chamber is provided with a quick closing damper 48 which is held by latch 49 in a manner similar to that described in connection with damper 26. A solenoid 50 tends to maintain the latch in engagement with an arm 51 on the damper while a spring 52 tends to release the latch. Conduit 45 is provided with an opening 53 to the atmosphere which is closed by damper 48 when the latter is held in raised position but which is open when the damper drops and closes the conduit 45.

An induced draft fan 54 is placed in conduit 45 and is operated by an electric motor 55. Motor 55 is provided with a governor 22b which actuates an electric switch 23b in the same manner as that described in connection with motor 15. Conduit 45 leads from fan 54 to suitable burners.

In Fig. 2 is shown a wiring diagram of the electric circuits connecting motors 15, 21 and 55 and solenoids 33 and 50. Current is supplied through leads 60 and 61 to an electric switch 62 provided with suitable fuses 63. A conductor 64 is connected to lead 61 and to one terminal of each of the motors and solenoids. A conductor 65 is connected to

lead 60 and directly to the other terminal of motor 55 used to operate induced draft fan 54. A conductor 66 is connected to lead 60 through conductor 65. Switches 23, 23a and 23b operated by governors 22, 22a and 22b on motors 15, 21 and 55 and a manually operable switch 67 are connected in series in conductor 66. Conductor 66 is connected to one terminal of motors 15 and 21 and solenoids 33 and 50. Motor 17 is also connected across conductors 64 and 66 and is provided with a switch 68 for stopping motor 17 independently of the other motors.

The operation of the device according to my invention is as follows:

Coal in lump form is supplied to hopper 16 in any suitable way and is fed by the feeder mechanism actuated by motor 17 to within drum 11. Drum 11 contains a number of steel balls 18 and is rotated by motor 15. The action of the lumps of coal falling against each other and against the steel balls and walls of the drum upon rotation of the latter causes the coal to be finally pulverized.

Preheated air is admitted to conduit 19 and is mixed with air at atmospheric temperature admitted through conduits 35 and the mixture is forced into drum 11 through the annular space between the opening in the discharge end of the drum and the discharge pipe 44. The air thus forced into the drum reverses its direction therein and passes out through discharge pipe 44, having picked up particles of coal which has been pulverized fine enough to be carried in suspension by the air draft. The temperature of the air passing out through discharge pipe 44 causes thermostatic element 43 to regulate valve member 41 so as to vary the pressure in conduit 40. If the temperature of the air discharge through pipe 44 is too low it will cause the contraction of the fluid in element 43 which will cause valve member 41 to move further away from vent 42 and thus allow the pressure in conduit 40, which is supplied with compressed air from any suitable source, to decrease. This will reduce the pressure of the air in cylinder 38 and allow spring 39 to move piston 37 so as to close damper 36 and thus reduce the amount of atmospheric air mixed with the preheated air and hence the temperature of the mixture will be increased. Likewise, if the temperature of the air passing through discharge pipe 44 is too high the automatic control of damper 36 will cause the damper to open and thus admit more cool air.

Dual valve 46 is used to regulate the amount of air passing from conduit 19 into drum 11 and hence regulates the velocity of this air. If the velocity is reduced less coal will be picked up in the drum and will be finer than with a higher velocity and hence valve 46 serves to regulate the quantity and

fineness of the coal delivered from the mill.

The mixture of air and coal is forced through conduit 45 by means of induced draft fan 54 to suitable burners where combustion of the air and coal is effected.

Ordinarily, when the burners are to be extinguished the supply of coal to drum 11 is first stopped by opening switch 68 which stops motor 17 operating the feed mechanism but the rotation of the drum is continued and the operation of the fan motors is continued until all of the coal in the drum has been pulverized and conveyed to the burners, whereupon the burners will be supplied with nothing but pure air and hence there will be no possibility of flame propagation back through conduit 45.

However, in the event it becomes necessary to immediately extinguish the burners because of some emergency, such as the failure of one or more boiler tubes, it is not possible to wait until the mill has been emptied of coal. It will be seen that when induced draft fan 54 is stopped the velocity of the flow of air and coal to the burners will decrease and the flame may strike back from the burner through conduit 45 to the mill, resulting in an explosion of the air and coal contained in the latter.

My invention overcomes this difficulty by providing a damper 48 in conduit 45 and a damper 26 in conduit 19. If it becomes necessary to suddenly extinguish the burner, switch 67 is opened. This opens the circuit of motors 15, 17 and 21 and solenoids 33 and 50, while leaving the circuit of motor 55 closed. Upon the failure of current supplied to solenoids 33 and 50 they immediately become de-energized and the springs 32 and 52, respectively, trip the latches 30 and 49 and allow dampers 26 and 48, respectively, to close the passageway through the conduits. The closing of conduit 19 stops the supply of air to the mill while the closing of conduit 45 immediately stops the further supply of air and pulverized coal to the burner. Opening 53 in conduit 45 is opened to the atmosphere and fan 54 draws air therethrough and forces it to the burner. Hence, flame propagation back through conduit 45 to the mill is prevented both by damper 48 being closed and by the fact that a blast of fresh air is forced through the conduit.

In the event that the supply of current to the mill fails entirely the same result will obtain, except that fan 54 will also stop, but while it is slowing down it will force fresh air from opening 53 to the burners.

If any of the motors 15, 21 or 55 stop for any reason whatsoever, whether it be an electrical or mechanical failure, the governor 22 associated with the motor which stops, will open its respective switch 23 which switch, being in series with switch 67, will have the

same effect as opening switch 67, previously described.

Once the mill has been stopped the dampers 26 and 48 must be reset by hand and they will not remain open unless the solenoids are energized.

Thus it will be seen that I have provided a safety system whereby a coal pulverizing mill may be shut down at a moment's notice without danger of explosion or which will shut down automatically upon the arising of abnormal conditions in its operation. For instance, in the event that either of the fan motors or the mill motor stops for any reason whatsoever, the governor associated with that motor opens the switch with which it is connected and thus interrupts the circuit of the solenoids and the forced draft fan and mill motors. Failure of the current supplied to the solenoids causes them to release the dampers, which close by gravity and instantaneously stop flow through the conduits. Of course, failure of current in the leads 60 and 61 will stop all motors and close the dampers.

While I have shown electrical means for controlling the system, it will be obvious that the same results can be accomplished by a pneumatic system. A series of elements such as that controlling the damper 36 may be used in place of the electrical members. Assume, for example, that tubes containing air under pressure are used instead of the electrical conduits of Fig. 2. The arrangement can be such that if the air pressure drops for any reason, the quick closing members 26 and 48 will be immediately shut. Compressed air can be used against pistons to hold the latches 30 and 49 in the position shown in Fig. 1. In case the compressed air pressure fails, the springs will move the latches to allow the quick closing members to close. In such an arrangement the centrifugal governors can hold the controlling valves in the pneumatic tubes in closed position to prevent a drop of pressure in the tubes. If the respective centrifugal governors slow down, they would open the valves controlled thereby so that the air pressure would drop and the operation would be the same as that above described.

While I have described my invention in connection with a pulverizer of a given type it is to be understood that this was by way of illustration only and that the invention is equally applicable to coal pulverizers of other types. Finally, my invention is not to be limited by what has been shown and described but its scope is to be gauged by the appended claims viewed in the light of the prior art.

What I claim is:

1. Combustion apparatus comprising, in combination, a coal pulverizer, means to feed coal to said pulverizer, a conduit for admitting air to said pulverizer, a fan for causing flow of air through said conduit, a discharge

conduit communicating with said pulverizer, a fan in said discharge conduit for causing flow therethrough of pulverized coal and air from said pulverizer, and means for stopping the first mentioned fan and substantially instantaneously closing both of said conduits while maintaining the second mentioned fan in operation.

2. Combustion apparatus comprising, in combination, a coal pulverizer, means to feed coal to said pulverizer, a conduit for admitting air into said pulverizer, a fan for causing flow of air through said conduit, a discharge conduit communicating with said pulverizer, a fan in said discharge conduit for causing flow therethrough of pulverized coal and air from said pulverizer, and means actuated by the stopping of the second mentioned fan for stopping the first mentioned fan and substantially instantaneously closing both of said conduits.

3. Combustion apparatus comprising, in combination, a coal pulverizer, means to feed coal to said pulverizer, a conduit for admitting air into said pulverizer, a fan for causing flow of air through said conduit, a discharge conduit communicating with said pulverizer, a fan in said discharge conduit for causing flow therethrough of pulverized coal and air from said pulverizer, and means actuated by the stopping of either of said fans for substantially instantaneously closing both of said conduits.

4. Combustion apparatus comprising, in combination, a coal pulverizer, means to feed coal to said pulverizer, a conduit for admitting air into said pulverizer, a fan for causing flow of air through said conduit, a discharge conduit communicating with said pulverizer, a fan in said discharge conduit for causing flow therethrough of pulverized coal and air from said pulverizer, and means actuated by the stopping of either of said fans for substantially instantaneously interrupting flow of air through the first mentioned conduit to said pulverizer and substantially instantaneously interrupting flow of pulverized coal and air from said pulverizer through said discharge conduit and establishing communication between said discharge conduit and the atmosphere.

5. Combustion apparatus comprising, in combination, a coal pulverizer, means to feed coal to said pulverizer, a conduit for admitting air into said pulverizer, a fan for causing flow of air through said conduit, a discharge conduit communicating with said pulverizer, a fan in said discharge conduit for causing flow therethrough of pulverized coal and air from said pulverizer, and means actuated by the stopping of the second mentioned fan for stopping the first mentioned fan and substantially instantaneously interrupting flow of air through the first mentioned conduit to said pulverizer and substantially in-

stantaneously interrupting flow of pulverized coal and air from said pulverizer through said discharge conduit and establishing communication between said discharge conduit and the atmosphere.

6. Combustion apparatus comprising, in combination, a drum, means to feed coal to said drum, means for pulverizing coal in said drum comprising means for rotating said drum, a conduit for admitting air into said drum, a fan for causing flow of air through said conduit, a discharge conduit communicating with said drum, a fan in said discharge conduit for causing flow therethrough of pulverized coal and air from said drum, and means for stopping the first mentioned fan and the rotation of said drum and substantially instantaneously interrupting flow through both of said conduits.

7. Combustion apparatus comprising, in combination, a drum, means to feed coal to said drum, means for pulverizing coal in said drum comprising means for rotating said drum, a conduit for admitting air into said drum, a fan for causing flow of air through said conduit, a discharge conduit communicating with said drum, a fan in said discharge conduit for causing flow therethrough of pulverized coal and air from said drum, and means actuated by the stopping of the second mentioned fan for stopping the first mentioned fan and the rotation of said drum and for substantially instantaneously interrupting flow through both of said conduits.

8. Combustion apparatus comprising, in combination, a drum, means to feed coal to said drum, means for pulverizing coal in said drum comprising means for rotating said drum, a conduit for admitting air into said drum, a fan for causing flow of air through said conduit, a discharge conduit communicating with said drum, a fan in said discharge conduit for causing flow therethrough of pulverized coal and air from said drum and means actuated by the stopping of either of said fans or the rotation of said drum for substantially instantaneously interrupting flow through both of said conduits.

9. Combustion apparatus comprising, in combination, a drum, means to feed coal to said drum, means for pulverizing coal in said drum comprising means for rotating said drum, a conduit for admitting air into said drum, a fan for causing flow of air through said conduit, a discharge conduit communicating with said drum, a fan in said discharge conduit for causing flow therethrough of pulverized coal and air from said drum and means actuated by the stopping of either of said fans or the rotation of said drum for substantially instantaneously interrupting flow of air through the first mentioned conduit to said drum and substantially instantaneously interrupting flow of air and pulverizing coal from said drum through

said discharge conduit and establishing communication between said discharge conduit and the atmosphere.

10. Combustion apparatus comprising, in combination, a drum, means for feeding coal to said drum, means for pulverizing coal in said drum comprising an electric motor for rotating said drum, a conduit for admitting air into said drum, a fan for causing flow of air through said conduit, a discharge conduit communicating with said drum, a fan in said discharge conduit for causing flow there-through of air and pulverized coal from said drum, a damper in said discharge conduit between said drum and said last mentioned fan, means comprising an electrically operated latch for retaining said damper in open position and means for substantially instantaneously closing said damper upon failure of electric current to said latch.

11. Combustion apparatus comprising, in combination, a drum, means for feeding coal to said drum, means for pulverizing coal in said drum comprising an electric motor for rotating said drum, a conduit for admitting air into said drum, a fan for causing flow of air through said conduit, an electric motor for actuating said fan, a discharge conduit communicating with said drum, a fan in said discharge conduit for causing flow there-through of air and pulverized coal from said drum, a damper in said discharge conduit between said drum and the last mentioned fan, means comprising an electrically operated latch for retaining said damper in open position, means for substantially instantaneously closing said damper upon failure of electric current to said latch and manually operable means for interrupting said electric current.

12. Combustion apparatus comprising, in combination, a drum, means for feeding coal to said drum, means for pulverizing coal in said drum comprising an electric motor for rotating said drum, a conduit for admitting air into said drum, a fan for causing flow of air through said conduit, an electric motor for actuating said fan, a discharge conduit communicating with said drum, a fan in said discharge conduit for causing flow there-through of air and pulverized coal from said drum, a damper in said discharge conduit between said drum and the last mentioned fan, means comprising an electrically operated latch for retaining said damper in open position, means for substantially instantaneously closing said damper upon failure of electric current to said latch, manually operable means for interrupting said electric current and means actuated by failure of the fan in said discharge conduit for interrupting said electric current.

13. Combustion apparatus comprising, in combination, a drum, means for feeding coal to said drum, means for pulverizing coal in

said drum comprising an electric motor for rotating said drum, a conduit for admitting air into said drum, a fan for causing flow of air through said conduit, an electric motor for actuating said fan, a discharge conduit communicating with said drum, a fan in said discharge conduit for causing flow there-through of air and pulverized coal from said drum, a damper in said discharge conduit between said drum and the last mentioned fan, means comprising an electrically operated latch for retaining said damper in open position, means for substantially instantaneously closing said damper upon failure of electric current to said latch, manually operable means for interrupting said electric current and means actuated by failure of either of said fans or of the motor rotating said drum for interrupting said electric current.

14. Combustion apparatus comprising, in combination, a drum, means for feeding coal to said drum, means for pulverizing coal in said drum comprising an electric motor for rotating said drum, a conduit for admitting air into said drum, a fan for causing flow of air through said conduit, an electric motor for actuating said fan, a damper in said conduit between said fan and said drum, a discharge conduit communicating with said drum, a fan in said discharge conduit for causing flow therethrough of air and pulverized coal from said drum, a damper in said discharge conduit between said drum and the last mentioned fan, means comprising electrically operated latches for retaining said dampers in open position and means for substantially instantaneously closing said dampers upon failure of electric current to said latches.

15. Combustion apparatus comprising, in combination, a drum, means for feeding coal to said drum, means for pulverizing coal in said drum comprising an electric motor for rotating said drum, a conduit for admitting air into said drum, a fan for causing flow of air through said conduit, an electric motor for actuating said fan, a damper in said conduit between said fan and said drum, a discharge conduit communicating with said drum, a fan in said discharge conduit for causing flow therethrough of air and pulverized coal from said drum, a damper in said discharge conduit between said drum and the last mentioned fan, means comprising electrically operated latches for retaining said dampers in open position, means for substantially instantaneously closing said dampers upon failure of electric current to said latches and manually operable means for interrupting said electric current.

16. Combustion apparatus comprising, in combination, a drum, means for feeding coal to said drum, means for pulverizing coal in said drum comprising an electric motor for rotating said drum, a conduit for admit-

ting air into said drum, a fan for causing flow of air through said conduit, an electric motor for actuating said fan, a damper in said conduit between said fan and said drum,

opening said air opening when said fan is stopped.

In testimony whereof I have affixed my signature.

MARTIN FRISCH.

70

5 a discharge conduit communicating with said drum, a fan in said discharge conduit for causing flow therethrough of air and pulverized coal from said drum, a damper in said discharge conduit between said drum
10 and the last mentioned fan, means comprising electrically operated latches for retaining said dampers in open position, means for substantially instantaneously closing said dampers upon failure of electric current
15 to said latches, manually operable means for interrupting said electric current and means actuated by failure of the fan in said discharge conduit for interrupting said electric current.

75

20 17. Combustion apparatus comprising, in combination, a drum, means for feeding coal to said drum, means for pulverizing coal in said drum comprising an electric motor for rotating said drum, a conduit for
25 admitting air into said drum, a fan for causing flow of air through said conduit, an electric motor for actuating said fan, a damper in said conduit between said fan and said drum, a discharge conduit communicat-
30 ing with said drum, a fan in said discharge conduit for causing flow therethrough of air and pulverized coal from said drum, a damper in said discharge conduit between said drum and the last mentioned fan, means
35 comprising electrically operated latches for retaining said dampers in open position, means for substantially instantaneously closing said dampers upon failure of electric current to said latches, manually operable
40 means for interrupting said electric current and means actuated by failure of either of said fans or of the motor rotating said drum for interrupting said electric current.

85

45 18. Combustion apparatus comprising a coal pulverizer, means for delivering coal and air to the pulverizer, a discharge conduit connected to the pulverizer, a fan in said conduit, a damper in said conduit intermediate the fan and the pulverizer, a nor-
50 mally closed air opening in said conduit intermediate the fan and the damper and means for cutting off the supply of coal and air to said pulverizer and for causing said damper to close the discharge conduit and
55 for opening the air opening therein without stopping said fan.

90

95

100

105

110

115

120

19. Combustion apparatus comprising a coal pulverizer, means for supplying coal and air to the pulverizer, a discharge conduit
60 connected to the pulverizer, a fan in said conduit, a damper in said conduit intermediate the fan and the pulverizer, a normally closed air opening in said conduit intermediate the fan and the damper and means for causing
65 the damper to close said conduit and for

125

130