May 3, 1932. M. W. ARROWOOD 1,856,902

APPARATUS FOR BURNING POWDERED FUEL

Original Filed Feb. 26, 1927 2 Sheets-Sheet 1

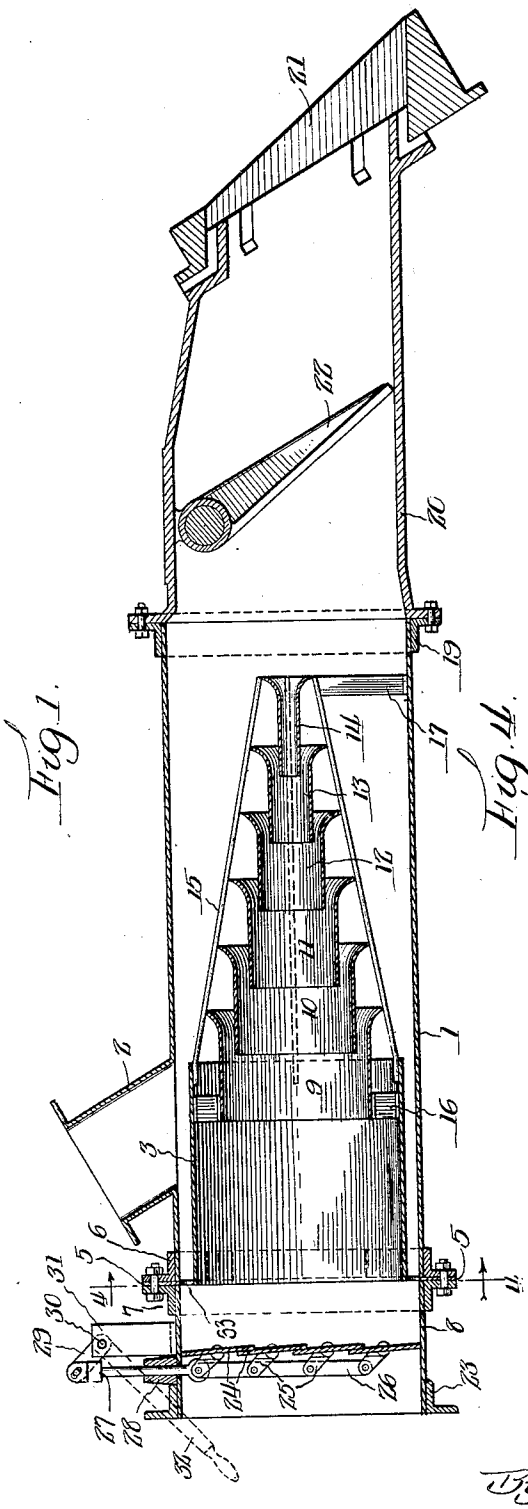

Fig. 1.

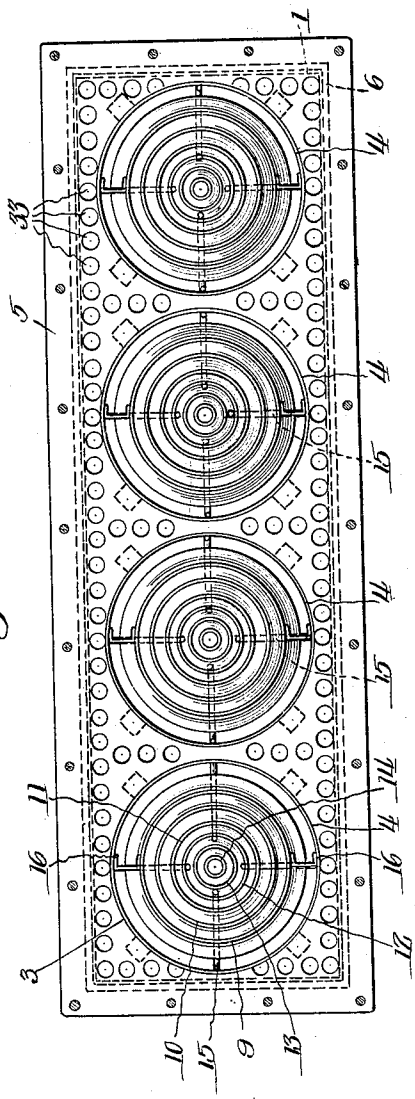

Fig. 4.

Inventor:
Milton W. Arrowood,
By Ira J. Wilson atty.

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Fig. 2.

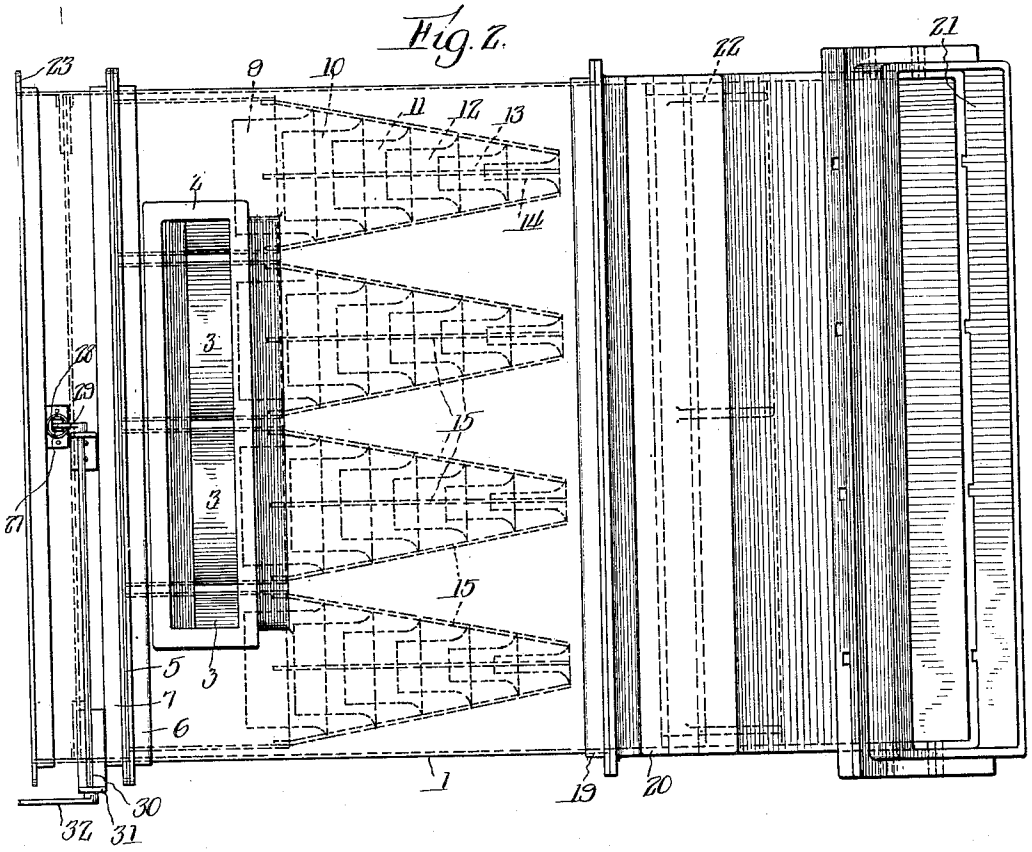
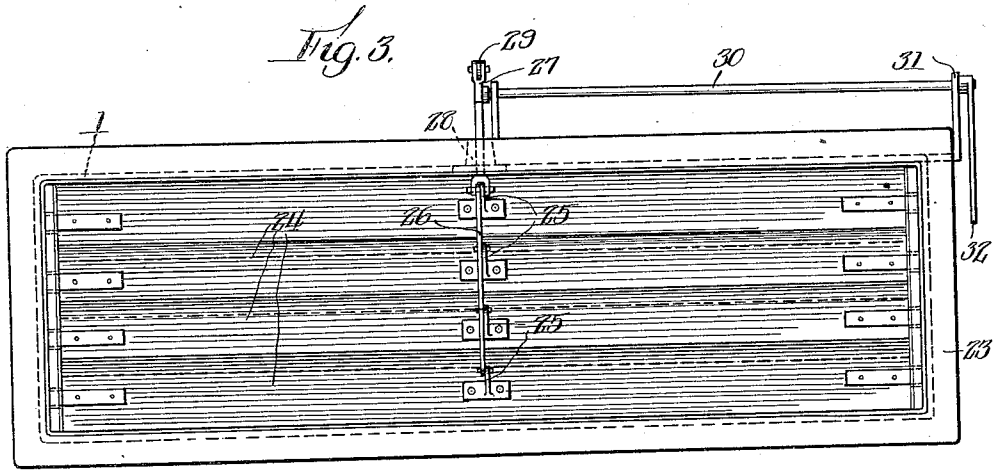


Fig. 3.



Inventor
Milton W. Arrowood,
By Ira J. Wilson atty

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UNITED STATES PATENT OFFICE

MILTON W. ARROWOOD, OF GREENWICH, CONNECTICUT

APPARATUS FOR BURNING POWDERED FUEL

Application filed February 26, 1927, Serial No. 171,098. Renewed March 18, 1932.

This invention relates to apparatuses for feeding powdered fuel. In apparatuses of this type a maximum of turbulence of the gases is desired in order to increase the rate of heat transference by breaking down resistance of gas films, etc. However, the amount of turbulence that can be had in a furnace is ordinarily limited unless the direction of the velocities of the gases is properly governed, as such gases might, unless so governed, be delivered directly to the stack, or cause excessive furnace temperatures and possible destruction of refractories, etc.

It is accordingly an object of this invention to provide an apparatus of the above type in which a maximum of turbulence of the gases is obtained, the directions of the velocities present in the gases being so governed that they do not cause unburned gases to be delivered to the stack even though the degree of such velocities is much higher than has heretofore been used.

More specifically it is an object of this invention to provide an apparatus of the above type in which whirls and eddies of extreme velocities are created in the gases.

It is further an object of this invention to provide an efficient mixer of the air and fuel to which the coal, if desired, may be delivered directly without necessitating such coal being broken up by a stream of air preliminary to its admission to said mixer.

Other and further objects of this invention will be apparent as the same becomes better understood from an examination of the specification and claims when taken in conjunction with the accompanying drawings, wherein

Fig. 1 represents a longitudinal sectional view of an apparatus embodying this invention.

Fig. 2 is a plan view of the apparatus.

Fig. 3 is an end view of the apparatus, and

Fig. 4 is a detail view of the plate which supports the intake ends of the cylinders 3 and communicates between the air supply, the interiors of said cylinders and the exteriors thereof.

Referring to the drawings more particularly, numeral 1 represents a cylindrical shell of rectangular cross section of a mixer and forms an outer conduit near one end of which is provided a transversely flanged connection 2 which is connected with a suitable feeder, for example, such as shown in connection with my copending application for United States Letters Patent for apparatus for feeding powdered fuel, Serial No. 624,927, filed March 14, 1923. The outer conduit 1 may be of any suitable cross section and in this instance is of rectangular shape and adapted to support a plurality of transversely spaced cylindrical members 3, the latter adapted to receive air under pressure and having their intake ends secured in transversely spaced apertures 4 respectively of a rectangular plate 5. The plate 5 is secured to the intake end of the shell 1 adjacent the connection 2 by means of flanges 6 and 7, the latter on a section 8 of rectangular cross-section communicating with said end. The cylindrical members 3 are adapted to receive therearound fuel from the opening within the connection 2 and each is provided at its discharge end with a set of cylindrically shaped deflector members 9 to 14 inclusive adapted to outwardly deflect the air discharged from the member 3 to create a maximum of turbulation in the stream of air thus discharged. The members 9 to 14 inclusive of each set are coaxial with their respective member 3, are longitudinally spaced and of successively decreasing diameters from the discharge end of said member 3 forwardly toward the discharge end of the shell 1. The successive deflector members have the intake of each thereof extending into the discharge end of the preceding one. Each of the deflector members has its discharge end flared to cause the air to commingle with the stream of air and fuel which is created around said members, as will be explained hereinafter, and is supported in proper relation with respect to the other deflector members of the series and the corresponding member 3 by supporting rods 15, which extend from the discharge end of the corresponding cylindrical member 3 and are attached to the deflector members. A suitable stay 16 one in the discharge end of each of the members 3 acts to support the intake

end of the corresponding deflector member 9 and another stay 17 in the discharge end of the shell 1 acts to support the discharge end of the series of deflector members.

The discharge end of the shell 1 is provided with an annular flange 19 which is connected by a similar flange to a suitable nozzle 20 communicating with a furnace 21 or the like desired to receive the mixture adapted to be discharged from the shell as it leaves the said nozzle. The nozzle 20 is preferably provided with a closure 22 for shutting off communication between the shell 1 and the furnace 21 when desired.

The section 8 contains the shutters for controlling the air supply to the shell 1 and is provided at the end therof opposite the flange 7 with a flange 23 which is adapted to be connected to a source of air supply. Within the section 8 there is pivotally mounted a plurality of vertically spaced transversely extending shutters 24, each of which is connected to an operating lever 25. Each of the levers 25 is pivotally connected at its outer end to a bar 26, the latter being pivotally connected at its upper end to the lower end of a rod 27 which is vertically slidable in a bearing 28 mounted in tne upper side of the section 8. The upper end of the rod 27 is connected to the outer end of a lever 29 which is rigidly secured on a transversely extending rod 30. The rod 30 is mounted in suitable supports 31 on the section 8 and is provided with a hand lever 32 manually operable for closing or opening the shutters 24 to control the communication between the source of air supply and the intake end of the shell 1.

In the operation of the apparatus the fuel in the form of powdered coal or a mixture thereof with air is admitted through the connection 2, such fuel falling by gravity around the cylinders 3 and being blown toward the discharge end of the shell 1 through means of the air coming from the source of air supply through a plurality of apertures 33 formed in the plate 5 around the apertures 4 therein. The shell 1 being of substantially uniform cross section from the intake to the discharge end thereof and the deflectors being of excessively decreasing size toward said discharge end, the column of air carrying the fuel which has been admitted through the connection 2 will be considerably rarefied toward said discharge end causing the fuel to be mixed with said air. Meanwhile the air entering the apertures 4 and the cylinders 3 will be given a maximum of turbulence through means of the deflectors by reason of the flared portions thereon. The flared portions on the deflectors will direct the air outwardly so as to cause it to commingle with the rarefied column of air and fuel around said deflectors. The deflectors being of successively diminishing size the pressure of the air coming through the cylinder 3 will not materially decrease throughout the successive deflectors.

The character of the turbulence of the mixture will be such that the pressure of the air can be very great without danger of obtaining too great a velocity in any given direction.

I am aware that many changes may be made and many details varied throughout a wide range without departing from the principles of this invention and I do not therefore wish to be limited to the details shown and described.

I claim:

1. In a device for feeding powdered fuel to a furnace, means for supplying powdered fuel and air to the furnace, means for creating turbulence in the powdered fuel and air including a series of axially aligned annular outward deflectors disposed in the line of flow, said deflectors being of successively decreasing diameters in the direction of said flow.

2. In a device for feeding powdered fuel to a furnace, means for supplying powdered fuel and air to the furnace, means for creating turbulence in the powdered fuel and air including a series of axially aligned annular outward deflectors disposed in the line of flow, said deflectors being of successively decreasing diameters in the direction of said flow, the successive deflectors each having the intake thereof extending into the discharge end of the preceding deflector.

3. In a device for feeding powdered fuel to a furnace, means for supplying powdered fuel and air to the furnace, means for creating turbulence in the powdered fuel and air including a series of annular deflectors disposed in the line of flow, said deflectors being of successively decreasing diameters in the direction of said flow and having the discharge ends thereof flared outwardly.

4. In a device of the character described, means for creating a turbulent stream of combustible mixture including a series of annular outward deflectors disposed in the line of flow, said deflectors being of successively decreasing size in the direction of said flow, and means for admitting a stream of air and fuel around said deflectors.

5. In a device of the character described, means for creating a turbulent stream of combustible mixture including a series of outward deflectors disposed in the line of flow, said deflectors being of successively decreasing size in the direction of said flow, a conduit surrounding said deflectors, and means for discharging a stream of air and fuel around said deflectors within said conduit.

6. In a device of the character described, means for creating a turbulent stream of combustible mixture including a conduit having communicating with the interior thereof a series of outward deflectors of successively

decreasing size in the direction of flow through said conduit, an outer conduit surrounding said first conduit and deflectors, and means for discharging a stream of air and fuel around said first conduit and deflectors within said outer conduit.

7. In a device of the character described, means for creating a turbulent stream of combustible mixture including a series of outward deflectors disposed in the line of flow, said deflectors being of successively decreasing size in the direction of said flow, a conduit surrounding said deflectors, and means for discharging a stream of air and fuel around said deflectors within said conduit, said conduit having an effective cross sectional area outside of said deflectors of increasing size toward its discharge end utilized for conducting the mixture of air and fuel.

8. In a device of the character described, means for creating a turbulent stream of combustible mixture including a conduit having communicating with the interior thereof a series of outward deflectors of successively decreasing size in the direction of flow through said conduit, an outer conduit surrounding said first conduit and deflectors, and means for discharging a stream of air and fuel around said first conduit and deflectors within said outer conduit, said outer conduit having an effective cross sectional area outside of said deflectors of increasing size toward its discharge end utilized for conducting mixed air and fuel.

9. In a device of the character described, a series of outward deflectors of successively decreasing size from the intake to the discharge end, a conduit surrounding said deflectors, means for admitting fuel to said conduit, and means for discharging air through said deflectors and through said conduit around the said deflectors.

10. In a device of the character described, a conduit and aligned therewith a series of spaced apart outward deflectors of successively decreasing size in the direction of flow through said conduit, an outer conduit surrounding said first conduit and deflectors, means for admitting fuel to said outer conduit outside of said first conduit, and means for discharging air through said first conduit and the spaced apart deflectors and through said outer conduit outside of said first conduit.

11. In a device of the character described, a conduit and aligned therewith a series of spaced apart outward deflectors of successively decreasing size in the direction of flow through said conduit, an outer conduit surrounding said first conduit and deflectors, means for admitting fuel to said outer conduit outside of said first conduit, and means for admitting air through said first conduit and deflectors and through said outer conduit outside of said first conduit, said last means including a plate secured to the intake end of said outer conduit, said plate having an aperture communicating with the intake end of said first conduit and a plurality of apertures surrounding said first aperture and communicating with the interior of said outer conduit outside of said first conduit.

12. In a device for feeding powdered fuel to a furnace, means for supplying powdered fuel and air to the furnace, means for creating turbulence in the powdered fuel and air including a series of spaced apart outward deflectors, disposed in the line of flow, said deflectors having successively decreasing cross sectional areas in the direction of said flow.

13. In a device for feeding powdered fuel to a furnace, means for supplying powdered fuel and air to the furnace, means for creating turbulence in the powdered fuel and air including a series of spaced apart outward deflectors disposed in the line of flow, said deflectors having successively decreasing cross sectional areas in the direction of said flow, the successive deflectors each having the intake thereof extending into the discharge end of the preceding deflector.

14. In a device for feeding powdered fuel to a furnace, means for supplying powdered fuel and air to the furnace, means for creating turbulence in the powdered fuel and air including a series of axially aligned annular deflectors disposed in the line of flow, said deflectors being of successively decreasing diameters in the direction of said flow and having the discharge ends thereof flared outwardly.

15. In a device for feeding powdered fuel to a furnace, means for supplying powdered fuel and air to the furnace, means for creating turbulence in the powdered fuel and air including a series of spaced apart deflectors disposed in the line of flow, said deflectors having successively decreasing cross sectional areas in the direction of said flow, the successive deflectors each having the intake thereof extending into the discharge end of the preceding deflector, said deflectors having the discharge ends thereof flared outwardly.

16. In a device for feeding powdered fuel to a furnace, means for supplying powdered fuel and air to the furnace, means for creating turbulence in the powdered fuel and air including a series of tubular deflectors disposed in the line of flow, said deflectors having successively decreasing cross sectional areas in the direction of said flow, the successive deflectors each having the intake thereof extending into the discharge end of the preceding deflector, said deflectors having the discharge ends thereof flared outwardly.

17. In a device for feeding powdered fuel to a furnace, means for supplying powdered

fuel and air to the furnace, means for creating turbulence in the powdered fuel and air including a series of annular members disposed in the line of flow, said members being of successively decreasing diameters in the direction of said flow, each member provided with a flared portion at its delivery end, the successive members each having the intake thereof extending into the delivery end of the preceding member beyond the flared portion thereof.

18. The method of feeding powdered fuel comprising admixing air with powdered fuel by deflecting in succession successively adjacent annular portions of a central stream of air outwardly into a surrounding stream of air containing powdered fuel.

19. In a device of the character described, a conduit, means for creating a hollow stream of fuel and air within the conduit and a central stream of air within the stream of fuel and air, and means within the conduit for deflecting at successively spaced intervals adjacent annular portions of the central stream of air outwardly into the surrounding stream of fuel and air.

20. In a device of the character described, a conduit, means for creating a hollow stream of fuel within the conduit and a central stream of air within the fuel, and means within the conduit including a series of longitudinally spaced outward deflectors for mixing the air with the fuel.

21. In a device of the character described, a conduit, means for creating a hollow stream of fuel within the conduit and a central stream of air within the fuel stream, and means within the conduit including a series of longitudinally spaced annular outward deflectors for mixing the air with the fuel.

22. In a device of the character described, a conduit, means for creating a hollow stream of fuel within the conduit and a central stream of air within the fuel, and means within the conduit including a series of longitudinally spaced annular outward deflectors of successively decreasing size for mixing the air with the fuel.

23. In a device of the character described, a conduit, means for creating a hollow stream of fuel within the conduit and a central stream of air within the fuel, and means within the conduit including a series of longitudinally spaced annular outward deflectors of successively decreasing size for mixing the air with the fuel, some of the successive deflectors each having the intake thereof extending into the delivery end of the preceding deflector an amount as great as its own diameter.

24. In a device for feeding powdered fuel to a furnace, means for creating turbulence in a mixture of the fuel and air including a series of spaced apart tubular outward deflectors disposed in the line of flow of air, said deflectors having successively decreasing cross sectional areas in the direction of said flow.

25. In a device for feeding powdered fuel mixed with air to a furnace, means for creating turbulence in the fuel mixture including a conduit and spaced apart outwardly flared tubular deflectors disposed in the line of flow of the air, means for admitting a flow of air into said conduit through said deflectors, means for admitting powdered fuel to said conduit at a position where deflected air currents will carry it into suspension in the air, several of said deflectors having different cross sectional areas adapted to deflect and impart eddying motion to various portions of the air stream at different distances from its center line of flow.

26. A method of creating and feeding a uniform turbulent mixture of fuel and air comprising forming a stream of air, forming the outermost layer of said air stream into an eddying body of moving air, adding the fuel to said eddying body, forming additional bodies of eddying air from said air stream and bringing these additional bodies successively into contact with the fuel mixture produced by said first body, and conducting the whole eddying mixture of fuel and air to a place for combustion.

27. A method of making and feeding a turbulent uniform mixture of fuel and air comprising forming an annular body of swiftly eddying air currents, adding fuel to said body and mixing it therewith, forming additional concentric coaxial annular bodies of swiftly eddying air currents and projecting them into contact with said first body and with each other in fuel mixing relation adapted to provide a total uniform mixture of fuel and air, and feeding said mixture while in substantially uniform turbulent condition to a place of combustion.

28. A method of making and feeding a uniform turbulent fuel mixture comprising forming an initial outer annular body of mixed fuel and air, forming within said body a series of additional inner annular bodies of air caused to move in swiftly eddying currents, and projecting said bodies in outward directions, and causing an ultimate uniform mixture by contacting said first body with the adjacent inner body so formed and each additional inner body with its respectively adjacent bodies.

In witness of the foregoing I affix my signature.

MILTON W. ARROWOOD.