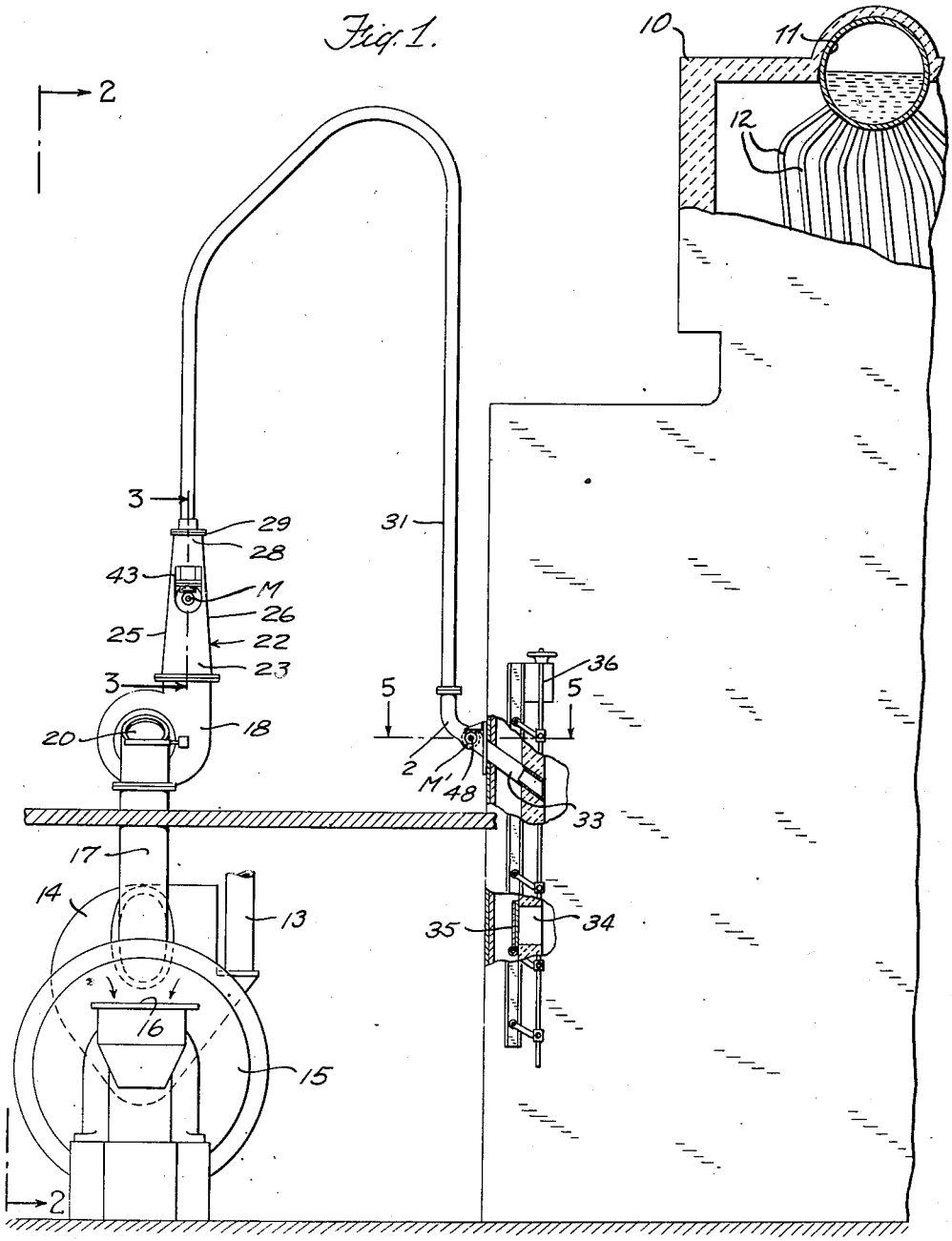
Aug. 21, 1951 M. FRISCH 2,564,683

DISTRIBUTOR

Filed Aug. 24, 1946 4 Sheets-Sheet 1

Fig. 1.



INVENTOR
MARTIN FRISCH
BY
E. Francis Wentworth Jr
ATTORNEY

Aug. 21, 1951 M. FRISCH 2,564,683

DISTRIBUTOR

Filed Aug. 24, 1946 4 Sheets-Sheet 2

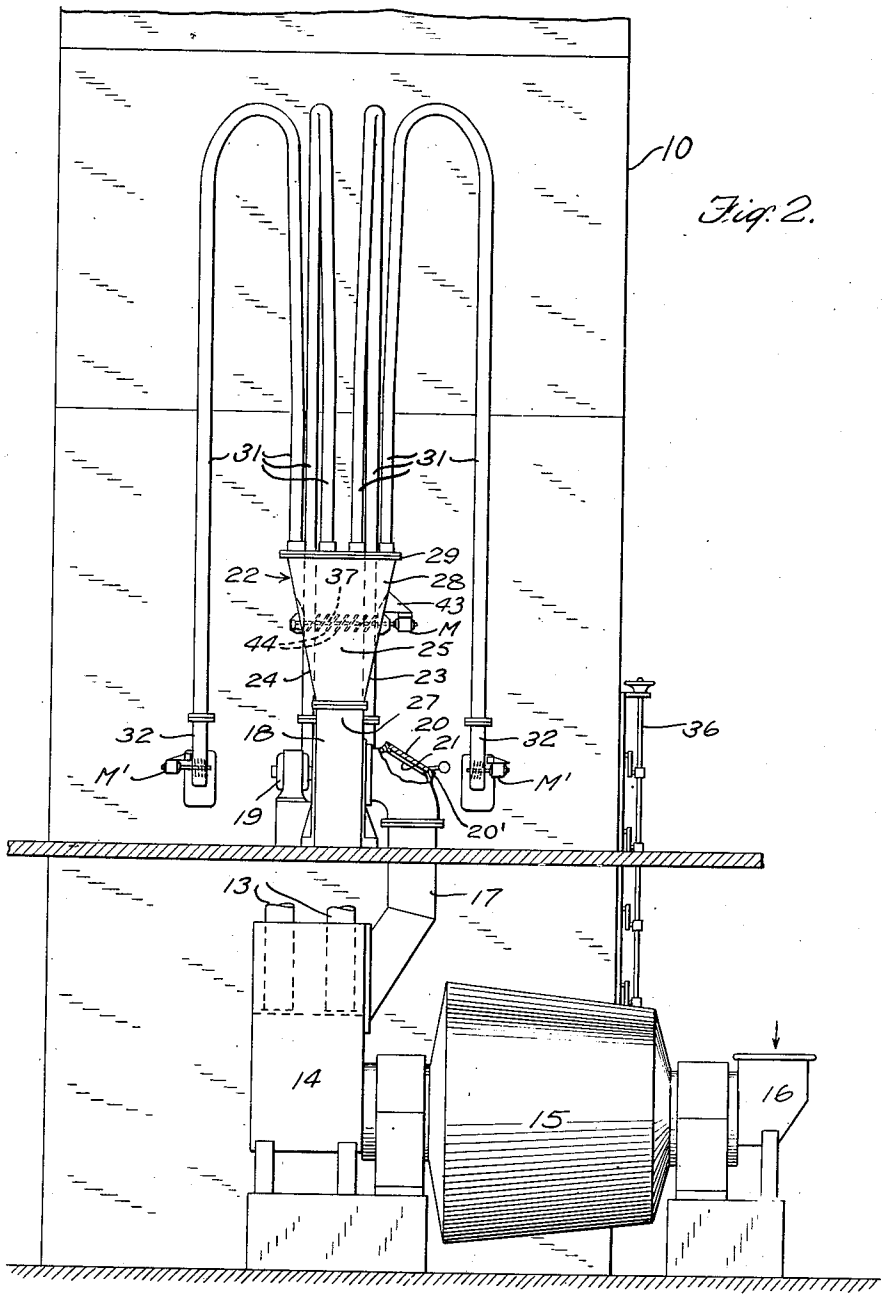


Fig. 2.

INVENTOR
MARTIN FRISCH
BY
E. Francis Wentworth Jr.
ATTORNEY

Aug. 21, 1951 M. FRISCH 2,564,683

DISTRIBUTOR

Filed Aug. 24, 1946 4 Sheets-Sheet 3

Fig. 3.

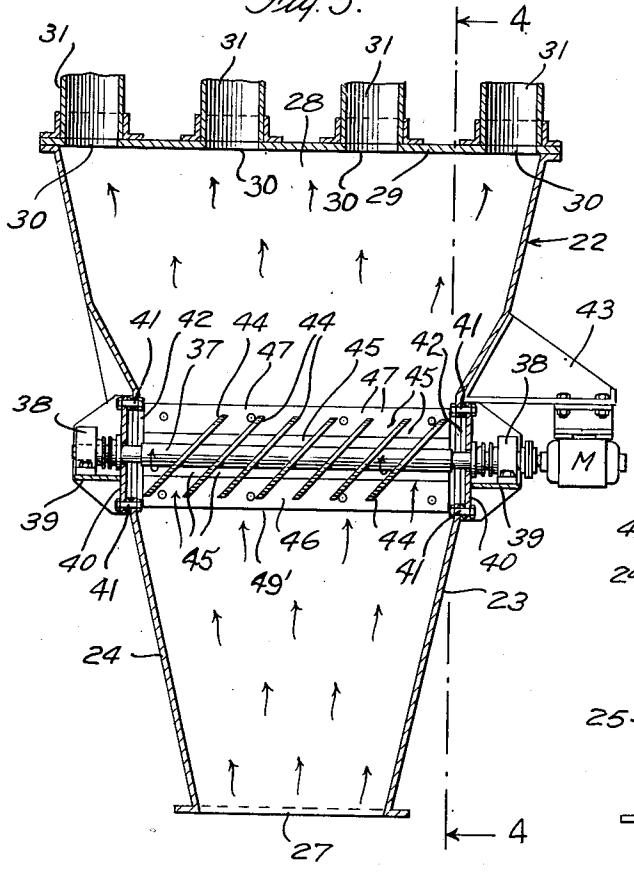


Fig. 4.

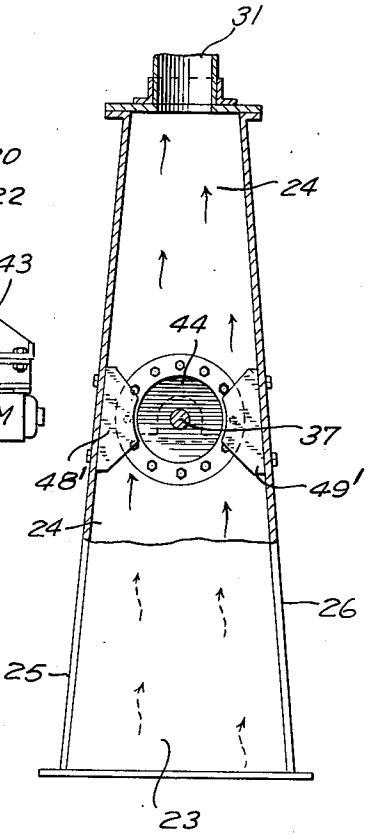
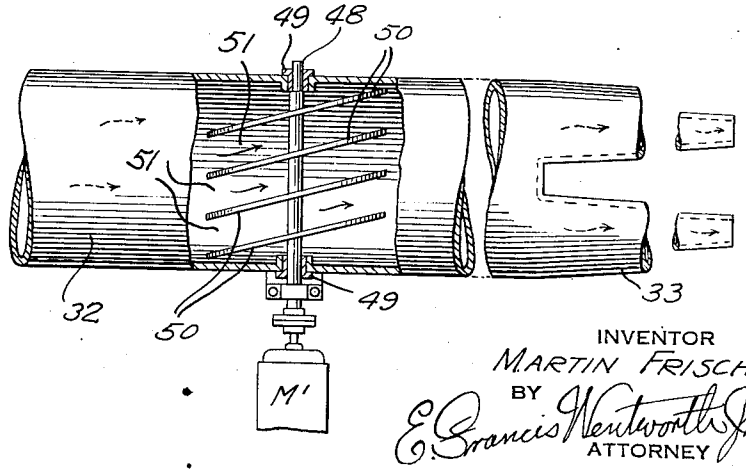


Fig. 5.



INVENTOR
MARTIN FRISCH
BY
E. Francis Wentworth Jr.
ATTORNEY

Aug. 21, 1951 M. FRISCH 2,564,683

DISTRIBUTOR

Filed Aug. 24, 1946 4 Sheets-Sheet 4

Fig. 7.

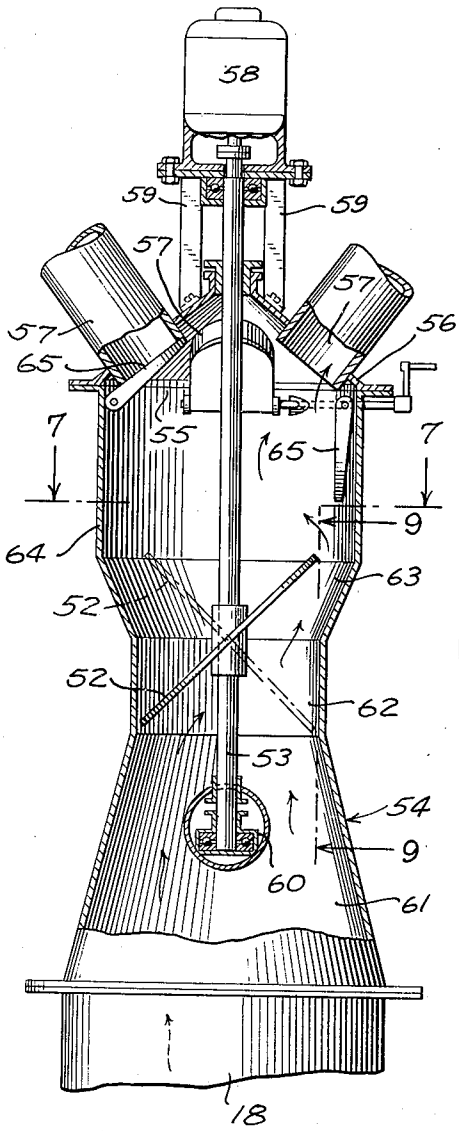


Fig. 6.

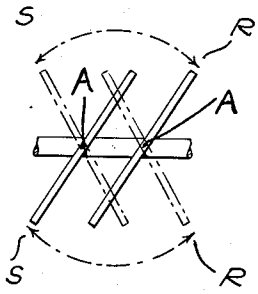
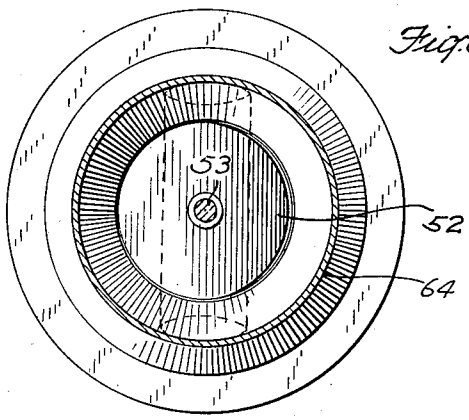


Fig. 8.



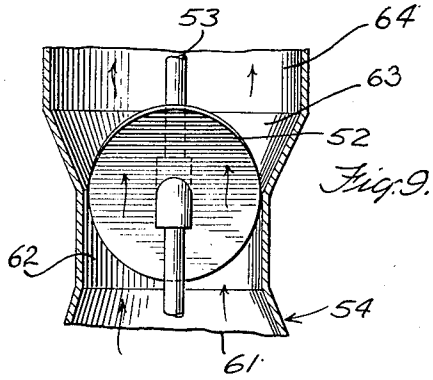


Fig. 9.

INVENTOR
MARTIN FRISCH
BY
E. Francis Wentworth Jr.
ATTORNEY

Patented Aug. 21, 1951

2,564,683

UNITED STATES PATENT OFFICE

2,564,683

DISTRIBUTOR

Martin Frisch, New York, N. Y., assignor to Foster Wheeler Corporation, New York, N. Y., a corporation of New York

Application August 24, 1946, Serial No. 692,872

13 Claims. (Cl. 302—28)

1

The present invention relates to distributors and more particularly to flow distributors.

This invention provides a distributor for distributing a fluid stream, which stream flows within a conduit, substantially equally to a plurality of outlets for said stream the outlets being in communication with the conduit.

The invention will be disclosed as applied to the distribution of pulverized fuel flowing from a pulverizer in a stream of air to a plurality of burners so that each burner is supplied with an amount of fuel substantially equal to that supplied to the other burners.

The invention will be understood from the following description when considered in connection with the accompanying drawings in which:

Fig. 1 is a more or less diagrammatic view partly in elevation and partly in section of pulverized fuel burning apparatus embodying the present invention;

Fig. 2 is a view taken on the line 2—2 of Fig. 1;

Fig. 3 is an enlarged sectional view taken on the line 3—3 of Fig. 1;

Fig. 4 is a sectional view taken on the line 4—4 of Fig. 3;

Fig. 5 is an enlarged horizontal sectional view taken on the line 5—5 of Fig. 1;

Fig. 6 is a diagrammatic view illustrating the operation of the distributor plates;

Fig. 7 is a vertical sectional view of another embodiment of the invention;

Fig. 8 is a transverse sectional view taken on the line 7—7 of Fig. 7, and

Fig. 9 is a vertical sectional view taken on the line 9—9 of Fig. 7.

Like characters of reference refer to the same or similar parts throughout the several views.

The forms of the invention disclosed are arranged for use with the furnace of steam generating apparatus but it will be understood that the invention is not limited to this particular application.

Referring particularly to Figs. 1 and 2 of the drawings, the reference character 10 designates the setting of a steam generator having an upper drum 11 to which is connected a bank of steam generating tubes 12. The steam generator may be of any desired form. The pulverizing apparatus disclosed in these figures of the drawings reduces the fuel to a finely divided form which fuel is entrained in a current of air and delivered to burners in communication with the combustion chamber of the steam generator. The fuel, for example bituminous coal, is delivered to feed

2

pipes 13 and is conducted through the fuel feed portions of a classifier 14 to a pulverizing mill 15 of any suitable type. As shown, the mill comprises a rotatable drum having pulverizing means such as a plurality of steel balls of varying diameters, not shown. Air, which is preferably preheated, is introduced into the mill through the air inlet 16 and sweeps entirely through the mill over the surface of the fuel being pulverized therein entraining reduced fuel and carrying it through the classifier 14 wherein the fuel particles not sufficiently pulverized are separated from the fuel and air stream and are returned to the mill 15. The air stream and entrained pulverized fuel then flows through discharge pipe 17 into an exhauster 18 which is driven by any suitable means such as an electric motor 19. A damper 20 is hingedly mounted at 20' in the pipe 17 and is movable in a counterclockwise direction on said hinge from the position shown in Fig. 2, in which position pipe 17 is fully opened and an opening 21 is completely closed, to a position in which the pipe 17 is completely closed and the opening 21 is fully opened. Damper 20, which may be operated manually or automatically, is adapted to be retained in any position intermediate the two positions mentioned to thereby close or open the opening 21 in the pipe 17 to varying degrees. Exhauster 18 delivers the fuel and air mixture into a distributing or hopper conduit 22 which has opposite end walls 23 and 24 and opposite side walls 25 and 26. As shown, the inlet end 27 of the hopper 22 is in communication with the outlet of the exhauster 18, while the outlet end 28 is covered by a plate 29 having a plurality of spaced outlets 30 therein. Delivery pipes 31 are connected into each of the outlets 30 at one end thereof, while the opposite end of the delivery pipes are in communication with a discharge nozzle 32. Each of the discharge nozzles 32 has a plurality of burner nozzles 33 at the discharge end thereof. The burner nozzles 33 discharge into the combustion chamber of the vapor generator, air being supplied to said combustion chamber through air discharge ports 34 controlled by dampers 35 which are operated by damper control apparatus 36.

A distributor is positioned in the hopper 22 intermediate the inlet and outlet ends thereof so that the pulverized fuel in the stream flowing through the hopper is distributed substantially equally among the delivery pipes 31. The distributor comprises a shaft 37 mounted to rotate in bearings 38 positioned on brackets 39 which brackets are secured to cover plates 40 removably

fastened by means of bolts 41 to opposite end walls 23 and 24 of the hopper. Cover plates 40 close an opening 42 in the walls 23 and 24 which are of such diameter that the distributor may be removed from the hopper, as will hereinafter be more fully described. Shaft 37, as shown in Figs. 1 to 6, extends substantially horizontally between end walls 23 and 24 of the hopper and intermediate the side walls 25 and 26 thereof. Electric motor M, which is removably secured to a bracket 43, rotates the shaft on its longitudinal axis. A plurality of spaced plates 44 which, as shown, are in the form of an elliptical-shaped disc and are positioned on the shaft so as to rotate therewith, the shaft 37 extending through the central portion of the plates 44. Flow paths 45 having an inlet 46 and an outlet 47 are thereby formed between adjacent plates 44. Plates 44 are positioned on the shaft at an angle other than a right angle to the axis of rotation of said shaft so that when the plates are rotated by the shaft they will oscillate on an axis, indicated at A, Fig. 6, extending in a plane transversely of the axis of rotation of shaft 37 so that flow paths 45 between adjacent plates 44 will oscillate on axis A between points R and points S (Fig. 6) causing the stream of air and entrained fuel to enter the inlets 46 of said flow paths from the inlet end 27 of the hopper in the area between said points R and S and to be discharged from the outlets 47 of said flow paths into the discharge end 28 of the hopper in the area of oscillation of said flow paths during rotation of the shaft 37. The plates 44 are of a width less than the distance between the side walls 25 and 26 and the spaces between the periphery of the plates and said walls are closed by guide blocks 48' and 49' which are secured to walls 25 and 26, respectively, the blocks being adapted to guide the stream of air and entrained fuel into passages 45 from the inlet end 27 of the hopper.

In operation, a mixture of primary air and pulverized fuel entrained therein is withdrawn from the mill 15 and after passing through the classifier 14 is withdrawn through pipe 17 by exhauster 18. The stream of primary air and entrained fuel is discharged from the exhauster 18 into the inlet end 27 of the hopper 22. The stream flows in the hopper from the inlet end 27 into the inlets 46 to enter flow paths 45 between adjacent plates 44. Since the plates 44 are rotated by shaft 37 about the horizontal axis of said shaft, the plates will oscillate on the transverse axis A, Fig. 6, in a plane extending transversely of the axis of the rotation of shaft 37 so that the flow paths 45 between adjacent plates will oscillate through areas between points R and S causing the stream of air with entrained pulverized fuel upon discharge from the outlet 47 of flow paths 45 to be distributed throughout the outlet end 28 of the hopper substantially equally to the outlets 30. The stream of air with pulverized fuel entrained therein distributed to the various outlets 30 flows through the delivery pipes 31 to the discharge nozzle 32 thence into the burner nozzles 33 whence it is introduced into the combustion chamber of the vapor generator.

As shown, the stream of fuel and air flowing in the discharge nozzle 32 is distributed to the burner nozzles 33 by apparatus similar to that used in distributing the stream of fuel and air to the delivery pipes 31. A substantially horizontally extending shaft 48 extends transversely of the discharge nozzle 32 and is mounted to rotate in bearings 49.

Shaft 48 is rotated by electric motor M'. A plurality of spaced plates 50 similar to plates 44 are positioned on the shaft 48 so as to rotate therewith. Plates 50, like plates 44, are positioned on the shaft at an angle other than a right angle to the axis of rotation of the shaft 48 so that when the plates are rotated by rotation of the shaft the plates will oscillate in a manner similar to the oscillation of plates 44, as hereinbefore described. The flow paths 51 between plates 50 are thereby oscillated causing the stream of fuel and air flowing from the delivery pipes 30 to the burner nozzles 33 to be distributed to the burner nozzles 33 in substantially the same manner that the stream of air and entrained fuel is distributed to the outlets 30 by the flow paths 45 between plates 44.

Should it be desired, the distributor may be removed from the hopper 22. Such removal is accomplished by removing bolts 41 and plates 40 which cover openings 42 thence removing bolts securing motor M to bracket 43. By moving the motor and shaft 37 to the right of Fig. 3, the distributor is withdrawn from the hopper 22, plates 44 passing through opening 42.

In the embodiment of the invention shown in Figs. 7 to 9, a single elliptical-shaped distributor disc 52 is mounted on a vertically extending shaft 53 to rotate therewith on the longitudinal axis of said shaft. The disc 52 is positioned on the shaft 53 at an angle other than a right angle to the axis of rotation of the shaft. The shaft 53 is mounted in a distributor casing 54 adapted to be positioned on the discharge end of the exhauster 18. The outlet end 55 of the casing 54 is enclosed by a cap 56 having a plurality of outlets 57 therein which outlets are positioned adjacent the periphery of the cap. Shaft 53 extends through cap 56 in the central portion thereof and is connected to electric motor 58 mounted on brackets 59 attached to cap 56. The opposite end of shaft 53 is mounted in a bearing support 60 within the casing 54.

The inlet end 61 of the casing 54 is in the form of a truncated cone with the base thereof toward the exhauster 18. Above the inlet end 61 is a cylindrical throat portion 62 which is in communication with an outwardly flared or inverted truncated cone section 63 which is a part of the cylindrically shaped outlet end 64 of the casing. The disc 52 is so positioned on the shaft 53 that substantially half the disc is within throat portion 62 and the other half adjacent the outwardly flared portion 63.

In operation, as the shaft 53 is rotated by the motor 58, the disc 52 rotates with said shaft on the longitudinal axis thereof. Rotation of the disc 52 on the longitudinal axis of the shaft causes an outlet opening to be formed around substantially 180° of the throat 62 so that air and entrained fuel may pass from the inlet end 61 of the casing 54 through substantially 180° of the throat 62 thence into substantially 180° of the outlet portion 64 of the casing. Continued rotation through one revolution of the disc 52 causes the disc to move from the position shown in full lines in Fig. 7 to the position shown in dot and dash lines so that a stream of air and entrained fuel will pass from the inlet portion 61 of the casing 54 through the throat 62 into the other half or 180° of the outlet portion 64 of casing 54. Air and fuel, when the disc is in such position, will be prevented from entering the first-mentioned 180° of the outlet portion 64 due to the close proximity of the disc

to 180° of the inside diameter of throat 62. It will be understood that the disc 52 is rotated at a relatively high speed so that the distribution of air and entrained fuel from one half of the outlet portion of casing 54 to the other half of said outlet portion occurs with great rapidity so that fuel and air are distributed substantially equally among outlets 57. As shown, outlets 57 are controlled by dampers 65.

While the invention has been disclosed as applied to the distribution of pulverized fuel flowing from a pulverizer in a stream of air to a plurality of burners for a vapor generator, it will be understood that this invention is not to be limited to such apparatus but is capable of use as a distributor for distributing a fluid stream which flows within a conduit substantially equally to a plurality of outlets for said conduit.

It will be understood that the forms of the invention disclosed are preferred forms and that changes may be made in the form, location and relative arrangement of the several parts of the apparatus disclosed without departing from the principles of the invention. Accordingly, the invention is not to be limited excepting by the scope of the appended claims.

What is claimed is:

1. Apparatus for distributing a fluid stream having solid particles entrained therein, said apparatus comprising a conduit having an inlet end and an outlet end with an inlet chamber at said inlet end, an outlet chamber at the outlet end and an intermediate passage connecting said chambers, the outlet end having a plurality of outlet openings in communication with the outlet chamber, a distributor in the intermediate passage, the distributor comprising at least one plate member mounted to rotate on a fixed axis and extending diagonally of said axis and on opposite sides thereof, said distributor being disposed in the intermediate passage to extend diagonally thereof and in the path of said fluid stream flowing from the inlet chamber to the outlet chamber, and means for continuously rotating said at least one plate member on said fixed axis.

2. Apparatus for distributing a fluid stream having solid particles entrained therein, said apparatus comprising a conduit having an inlet end and an outlet end with an inlet chamber at said inlet end, an outlet chamber at the outlet end and an intermediate passage connecting said chambers, the outlet end having a plurality of outlet openings in communication with the outlet chamber, a distributor in the intermediate passage, the distributor comprising at least one flat plate member mounted to rotate on a fixed axis and extending diagonally of said axis and on opposite sides thereof, said distributor being disposed in the intermediate passage to extend diagonally thereof and in the path of said fluid stream flowing from the inlet chamber to the outlet chamber, and means for continuously rotating said at least one flat plate member on said fixed axis.

3. Apparatus for distributing a fluid stream with pulverized fuel entrained therein comprising a conduit having an inlet end and an outlet end with an inlet chamber at said inlet end, an outlet chamber at the outlet end and an intermediate passage connecting said chambers, the outlet end having a plurality of outlet openings in communication with the outlet chamber, a distributor in the intermediate passage, the distributor comprising at least one disc mounted at the center thereof to rotate on a fixed axis and extending diagonally of said axis and on opposite sides thereof, said distributor being disposed in the intermediate passage to extend diagonally thereof and in the path of said fluid stream flowing from the inlet chamber to the outlet chamber, and means for continuously rotating said at least one disc on said fixed axis.

4. Apparatus for distributing a fluid stream comprising a conduit having an inlet end and an outlet end with an inlet chamber at said inlet end, an outlet chamber at the outlet end and an intermediate passage connecting said chambers, the outlet end having a plurality of outlet openings in communication with the outlet chamber, a distributor in the intermediate passage, the distributor comprising a plurality of plate members mounted to rotate on a fixed axis extending transversely of the intermediate passage, the plate members being spaced from one another longitudinally of said axis from one side to the other of the intermediate passage and extending diagonally of said axis and on opposite sides thereof in the path of a fluid stream flowing from the inlet chamber to the outlet chamber, and means for rotating said plate members on said fixed axis.

5. Apparatus for distributing a fluid stream comprising a substantially vertically extending conduit having an inlet end and an outlet end with an inlet chamber at said inlet end, an outlet chamber at the outlet end and an intermediate passage connecting said chambers, the outlet end having a plurality of outlet openings in communication with the outlet chamber, a distributor in the intermediate passage, the distributor comprising a plurality of plate members mounted to rotate on a fixed axis extending horizontally and transversely of the intermediate passage, the plate members being spaced in parallel relationship to one another longitudinally of said axis from one side to the other of the intermediate passage and extending diagonally of said axis and on opposite sides thereof in the path of a fluid stream flowing from the inlet chamber to the outlet chamber, and means for simultaneously rotating all of said plate members on said fixed axis.

6. Apparatus for distributing an air stream having pulverized fuel entrained therein comprising a substantially vertically extending conduit having an inlet end and an outlet end with an inlet chamber at said inlet end, an outlet chamber at the outlet end and an intermediate passage connecting said chambers, the outlet end having a plurality of outlet openings in communication with the outlet chamber, a distributor in the intermediate passage, the distributor comprising a shaft rotatably mounted in said intermediate passage and extending transversely thereof in a horizontal plane, a plurality of discs mounted on the shaft to rotate therewith, said shaft passing through the centers of said discs, the discs extending diagonally of the longitudinal axis of the shaft and spaced in parallel relationship to one another longitudinally of the shaft from one side to the other of the intermediate passage, and means for rotating said shaft.

7. Apparatus for distributing an air stream having pulverized fuel entrained therein comprising a substantially vertically extending conduit having an inlet end and an outlet end with an inlet chamber at said inlet end, an outlet chamber at the outlet end and an intermediate passage connecting said chambers, the outlet end having

a plurality of outlet openings in communication with the outlet chamber, a distributor in the intermediate passage, the distributor comprising a shaft removably and rotatably mounted in said intermediate passage and extending transversely thereof in a horizontal plane, a plurality of discs mounted on the shaft to rotate therewith, said shaft passing through the centers of said discs, the discs extending diagonally of the longitudinal axis of the shaft and spaced in parallel relationship to one another longitudinally of the shaft from one side to the other of the intermediate passage, and means for rotating said shaft.

8. Apparatus for distributing a fluid stream comprising a substantially vertically extending conduit having an inlet end and an outlet end with an inlet chamber at said inlet end, an outlet chamber at the outlet end and an intermediate passage connecting said chambers, the outlet end having a plurality of outlet openings in communication with the outlet chamber, a distributor in the intermediate passage, the distributor comprising a rotatably mounted shaft extending vertically through the intermediate passage, a single plate in the intermediate passage mounted on said shaft to rotate therewith, said plate extending diagonally of the longitudinal axis of the shaft on opposite sides thereof and diagonally of said intermediate passage, and means for rotating said shaft.

9. Apparatus for distributing a fluid stream comprising a conduit with an inlet end and an outlet end, the outlet end having a plurality of spaced outlet openings in communication with said conduit, a distributor positioned in said conduit adjacent to and in spaced relationship with said outlet end and said openings such distance as to provide an outlet chamber between said outlet end and the distributor, the distributor also being so positioned in the conduit in spaced relationship with the inlet end such distance as to provide an inlet chamber between said inlet end and the distributor, the distributor comprising at least one plate member mounted to rotate on a fixed axis and extending diagonally of said axis and on opposite sides thereof, said distributor being disposed in the conduit to extend diagonally of the longitudinal axis thereof and in the path of said fluid stream flowing from the inlet chamber to the outlet chamber of said conduit, and means for continuously rotating said at least one plate member on said fixed axis.

10. Apparatus for distributing a fluid stream comprising a conduit with an inlet end and an outlet end, the outlet end having a plurality of spaced outlet openings in communication with said conduit, a distributor positioned in said conduit adjacent to and in spaced relationship with said outlet end and said openings such distance as to provide an outlet chamber between said outlet end and the distributor, the distributor also being so positioned in the conduit in spaced relationship with the inlet end such distance as to provide an inlet chamber between said inlet end and the distributor, the distributor comprising at least one disc mounted at the center thereof to rotate on a fixed axis and extending diagonally of said axis and on opposite sides thereof, said distributor being disposed in the conduit to extend diagonally of the longitudinal axis thereof and in the path of said fluid stream flowing from the inlet chamber to the outlet chamber of said conduit, and means for continuously rotating said at least one disc on said fixed axis.

11. Apparatus for distributing a fluid stream comprising a conduit with an inlet end and an outlet end, the outlet end having a plurality of spaced outlet openings in communication with said conduit, a distributor adjacent to and in spaced relationship with said outlet end and said openings, the distributor comprising a plurality of plate members mounted to rotate on a fixed axis extending transversely of the longitudinal axis of the conduit, the plate members being spaced from one another longitudinally of said fixed axis from one side to the other of the conduit and extending diagonally of said fixed axis and on opposite sides thereof in the path of a fluid stream with solid particles entrained therein flowing from the inlet end to the outlet end of said conduit, and means for rotating said plate members on said fixed axis.

12. Apparatus for distributing a fluid stream comprising a vertically extending conduit with an inlet end and an outlet end, the outlet end having a pluraltiy of spaced outlet openings in communication with said conduit, a distributor positioned in said conduit adjacent to and in spaced relationship with said outlet end and said openings such distance as to provide an outlet chamber between said outlet end and the distributor, the distributor also being so positioned in the conduit in spaced relationship with the inlet end such distance as to provide an inlet chamber between said inlet end and the distributor, the distributor comprising a rotatably mounted shaft extending vertically in the conduit, a single plate in the conduit mounted on said shaft to rotate therewith, said plate extending diagonally of the longitudinal axis of the shaft on opposite sides thereof and diagonally of said conduit in the path of said fluid stream flowing from the inlet chamber to the outlet chamber of said conduit, and means for rotating said shaft.

13. Apparatus for distributing a stream of air having pulverized fuel entrained therein, said apparatus comprising a substantially vertically extending conduit having an inlet end and an outlet end with an inlet chamber at said inlet end, an outlet chamber at the outlet end and an intermediate passage connecting said chambers, the outlet end having a plurality of outlet openings in communication with the outlet chamber, a distributor in the intermediate passage, the distributor comprising a rotatably mounted shaft extending vertically through the intermediate passage, a single plate in the intermediate passage mounted on said shaft to rotate therewith, said plate extending diagonally of the longitudinal axis of the shaft on opposite sides thereof and diagonally of said conduit throughout substantially the entire inside diameter thereof, and means for rotating said shaft.

MARTIN FRISCH.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
Re. 21,878	Frisch	Aug. 19, 1941
898,818	Aiken	Sept. 15, 1908
1,641,470	Bell	Sept. 6, 1927
1,831,066	Gleason	Nov. 10, 1931
2,400,703	Messinger	May 21, 1946