

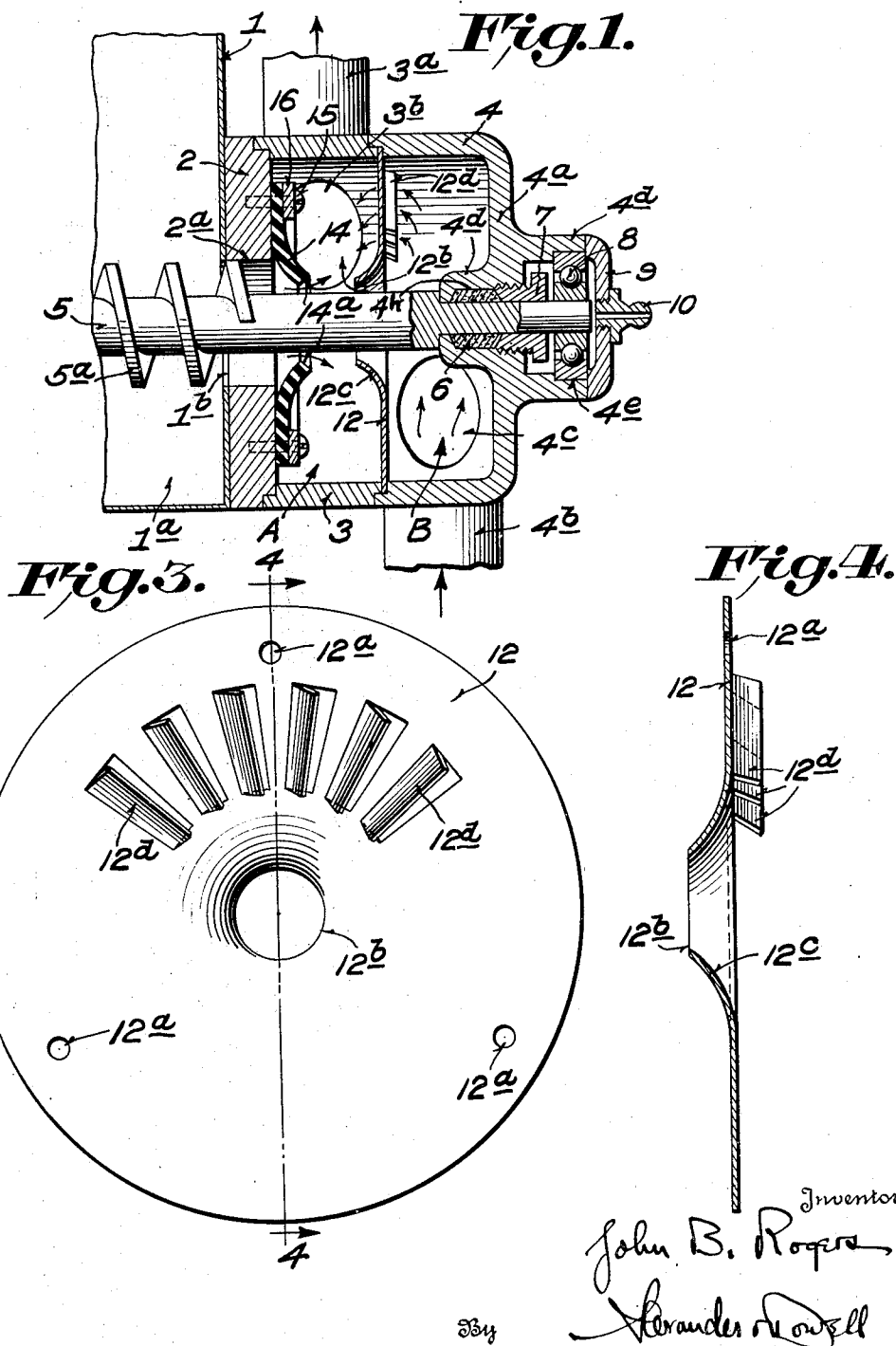
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INVERTED FEED CARBURETOR FOR PULVERIZED
COAL OR THE LIKE

2,489,980

Filed June 1, 1948

2 Sheets-Sheet 1



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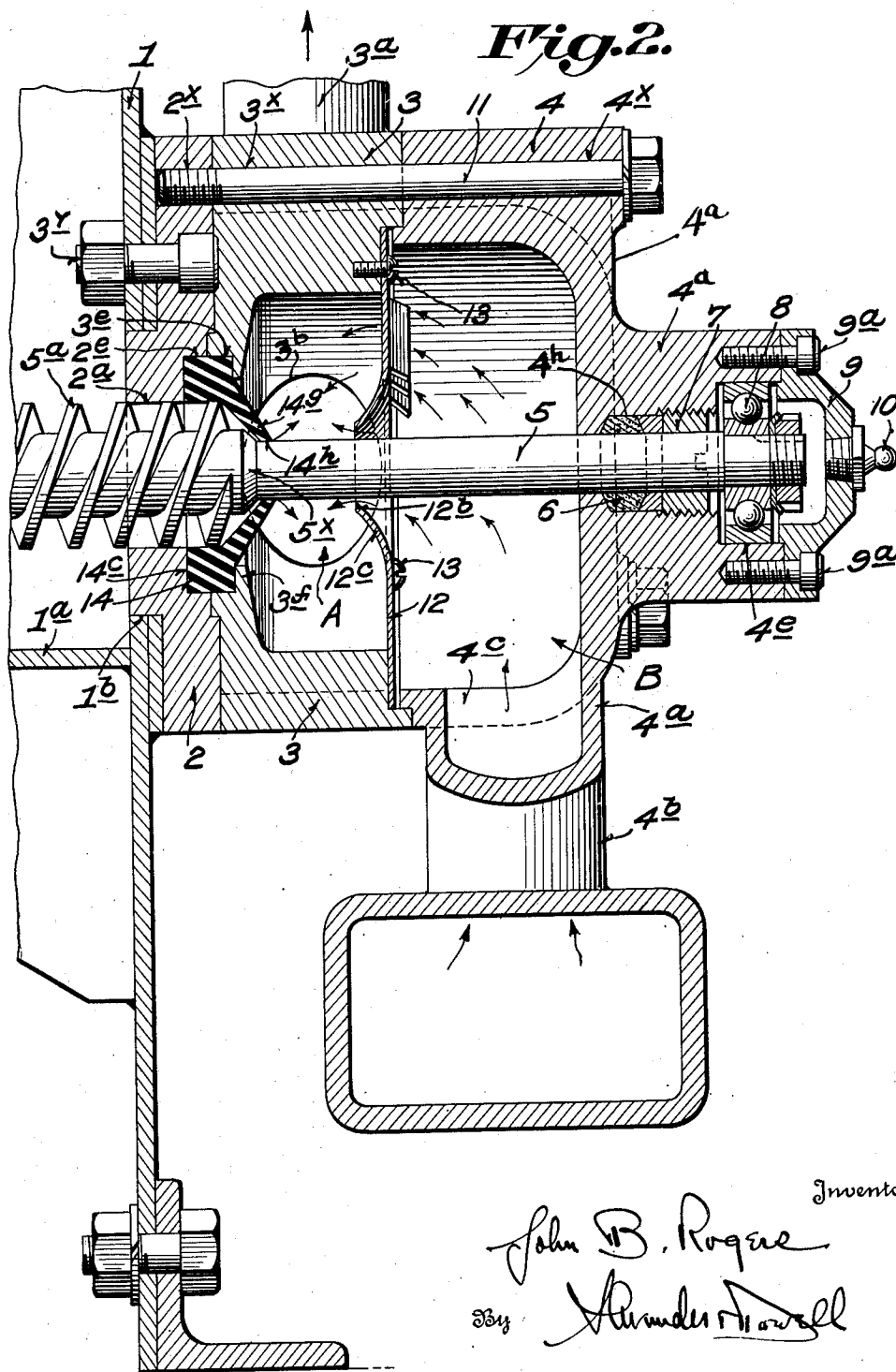
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UNITED STATES PATENT OFFICE

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INVERTED FEED CARBURETOR FOR PULVERIZED COAL OR THE LIKE

John B. Rogers, Pasadena, Md.

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16 Claims. (Cl. 302—50)

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This invention is a novel inverted feed carburetor for pulverized coal or the like, adapted to feed in a continuous operation the coal from a hopper, at atmospheric pressure, into a mixing chamber having an air pressure above atmospheric for thorough admixture of the pulverized coal with the stream of high-pressure air passing through said carburetor.

My present invention is an improvement upon that disclosed in my U. S. Letters Patent No. 2,428,995, issued October 14, 1947; and upon that disclosed in my (joint) application, Serial No. 772,034, filed September 4, 1947; and upon that disclosed in my (sole) application, Serial No. 26,173, filed May 10, 1948.

The principal object of the present invention is to provide novel means for mixing air and a finely divided or pulverized coal in as nearly perfectly constant proportions as possible. The pulverized coal is introduced into my carburetor by means of a feed throat valve arranged to bring the coal into the carburetor in an almost perfectly even flow, it being the function of the carburetor to mix this even flow of coal into an even flow of air under pressure, in as nearly perfectly constant proportions as possible. To do this, the coal must be first removed from its point of entry, i. e., the perimeter of the valve seat, immediately and completely; and secondly, the coal must be thoroughly mixed into the air immediately after its removal from the valve seat.

A further object of the invention is to provide a carburetor of the above type in which the air is initially introduced tangentially into the plenum chamber disposed at the outer end of the carburetor to impart to the air a rotary motion therein, thereby distributing the air therein evenly with respect to an annular series of louvres separating the plenum chamber and the mixing chamber of the carburetor which latter is disposed at the inner end of the carburetor around the feed throat valve, said louvres being disposed at an acute angle to the flow of the air and their combined area being such that with proper air volume and pressure, the rotation of the air in the mixing chamber is increased greatly and its velocity is stepped up to such point that the whirling high velocity air in the mixing chamber is directed onto and completely around the perimeter of the feed throat valve seat to remove the solid material from the feed throat valve in a positive manner, the solid material and high velocity air whirling around within the mixing chamber. Thus it can be seen

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that I accomplish the first of my objectives by supplying air at a great enough velocity to insure the removal of the pulverized coal as fast as it is fed through the feed valve and with enough pressure to make the operation perfectly positive.

My second objective is accomplished by the great turbulence created by the high air velocities used. From the distribution side of the louvres on—and as far as desired to convey it pneumatically, the velocity of the air is never allowed to fall below 5000 feet per minute—this velocity in the mixing chamber creating an intense turbulence which thoroughly mixes the solid material with the air.

I will explain the invention with reference to the accompanying drawings, which illustrate one practical embodiment thereof to enable others familiar with the art to adopt and use the same; and will summarize in the claims the novel features of construction, and novel combinations of parts, for which protection is desired.

In said drawings:

Figure 1 is a longitudinal section through one embodiment of my invention, showing the carburetor and adjacent parts of the hopper.

Fig. 2 is a longitudinal section through a modified form of carburetor, showing the adjacent parts of the hopper.

Fig. 3 is an enlarged plan view of the air flow disc used in both modifications shown in Figs. 1 and 2.

Fig. 4 is a transverse section on the line 4—4, Fig. 3.

Feed hopper 1 is provided with a bottom 1a, and with an opening 1b in its end communicating with the bore 2a of a relatively thick base plate 2, which is secured to the end of the hopper 1 by bolts 3y or the like, as shown in Fig. 2, said base plate 2 being preferably of circular plan.

Beyond base plate 2 is an annular casing 3 open at both ends and preferably of same diameter as the base plate 2, casing 3 having a tangentially disposed outlet pipe 3a communicating with the interior of casing 3 by means of an outlet opening 3b, as shown.

Beyond the annular casing 3 is an annular casing 4 of preferably same diameter as casing 3, the same being open at its inner end and closed at its outer end by a wall 4a, said casing 4 having a tangentially disposed inlet pipe 4b communicating with the interior of casing 4 through an inlet opening 4c, as shown.

At the center of end wall 4a is a hub 4d oppo-

site the bore 2a of base plate 2, in which hub is journaled the outer end of a shaft 5 which carries a conveyor flight 5a which latter terminates within the end of bore 2a of base plate 2, said flight extending into the hopper 1.

Within the hub 4d around the shaft 5 is a packing 6, housed in an enlargement 4h of the hub bore and normally compressed by an annular collar 7 which is tapped into the enlargement 4h of the bore; and beyond collar 7 is an anti-friction bearing 8 for the shaft 5, housed in an enlargement 4e of the hub 4d, the outer end of the hub 4d being closed by a cap or plate 9, which is preferably secured to the end of hub 4d by screws 9a or the like (Fig. 2). In order to lubricate bearing 8, a nipple 10 may be provided in the plate 9 opposite the end of shaft 5. Any other desired means for lubricating the bearing, however, may be used.

The casings 3—4 are secured to the base plate 2 by means of bolts 11 or the like, which pass through registering bores 3x—4x in the casings 3—4 and have their inner ends threaded into tapped bores 2x in base plate 2, as shown in Fig. 2. However, any other desired means for securing the members 2—3—4 together may be used.

Mounted across the outer face of the casing 3 is an air flow disc 12, shown more particularly in Figs. 3 and 4, disc 12 having an annular series of holes 12a adjacent its periphery for receiving screws 13 (Fig. 2) which pass through the holes and are tapped into the outer end of casing 3, the disc 12 thus separating the interior of the casings 3 and 4 into a mixing chamber A and a plenum chamber B. At the center of disc 12 is a circular opening 12b, and the central portion of the disc is substantially conically offset as at 12c in the direction of the mixing chamber A, as shown, thereby providing an annular opening around the shaft 5 directed towards the mixing chamber A, in order that some of the air under pressure from plenum chamber B will be directed by the conical offset portion 12c and discharged into the mixing chamber A around and substantially axially of the shaft 5.

In the disc 12 between the wall of chamber A and the conical portion 12c is a complete annular series of louvres 12d which are preferably struck out of the body of the plate 12, said louvres 12d sloping in the same direction and being disposed at the same angle to the plane of disc 12, the angle being substantially but not necessarily 45 degrees. Thus air under pressure entering plenum chamber B through the tangential inlet pipe 4b is given a swirling motion, as indicated by the arrows (Figs. 1 and 2), some of the air passing through the central opening 12b of disc 12 along the shaft 5 and into mixing chamber A, while the remainder of the air passes through the angularly disposed louvres 12d, thereby imparting a swirling motion to the air under pressure within mixing chamber A before passing through the outlet 3a.

In Fig. 1, conveyor flight 5a is shown as making a close sliding fit within bore 2a of base plate 2. On the outer face of base plate 2 is a resilient valve 14 comprising a normally flat rubber disc having its periphery secured by screws 15 or the like to the face of base plate 2, an annular ring 16 being interposed between the heads of screws 15 and the periphery of the valve disc. Valve 14 has an axial opening 14a at its center normally contacting the periphery of the shaft 5, but owing to the flexibility of the valve disc, when pulverized coal is fed along the shaft 5 by conveyor

flight 5a the central portion of the valve disc will be deflected and will assume the shape shown in Fig. 1, thereby permitting the coal to be discharged into mixing chamber A around the periphery of shaft 5, the resilience of the valve, assisted by the air pressure within chamber A, normally restoring the valve 14 to its flat condition when the pressure of the coal is relieved or sufficiently reduced.

In feeding pulverized coal for combustion it is of paramount importance to bring as nearly a perfectly even stream of coal as possible into the virtually perfectly even stream of air produced by a centrifugal or axial blower or compressor. The feed throat valve 14 serves two purposes; first, it creates a slight back pressure against the pulverized coal being fed by the flight 5a and thus compacts this coal so as to provide a uniform condition in the coal at the point just before same passes beyond the valve. At the same time, valve 14 prevents the end of the flight 5a from pushing an excessive amount of coal into the air stream as it passes the bottom of the feed throat 2a. I have found that a worm feed is inherently uneven without a device such as valve 14 which literally holds the coal back from the overfeed phase of each revolution to fill in the discrepancy of the underfeed cycle. Second, as in most cases it is necessary for the proper handling and combustion of pulverized coal to use air at a pressure of one-half pound or more, the valve 14 is designed to prevent this air from blowing back through the feed throat 2a which will cause very erratic feeding or will stop the pulverized coal from feeding altogether.

After the pulverized coal has been fed into the carburetor at an even rate, it is then necessary to move it away from the point of entry immediately and completely, at the same time to mix the coal thoroughly with the combustion air which will also be used to convey it to the point of combustion. This is accomplished in my carburetor—first, by directing a small proportion of the air through the opening 12b in the center of the disc 12 between the plenum chamber B and the mixing chamber A along the shaft 5 and against the incoming coal at its point of entry under the feed valve lip and around the shaft 5 in such a manner and at such a velocity as to remove it immediately and completely from its point of entry. This air throws the coal from the point of entry out into the mixing chamber A where it is picked up by the whirling air introduced into the mixing chamber through the louvres 12d disposed in the partition between the mixing chamber and the plenum chamber. These louvres are disposed at such an angle, and their area is such, that the velocity of the air entering the mixing chamber A is built up to the highest practical rate. This accelerates the whirling action of the air in the mixing chamber A and the turbulence thus created mixes the air and coal thoroughly before it leaves the carburetor.

As an example of how important it is to feed pulverized coal evenly and mix it thoroughly with the combustion air, it requires upwards of one hundred cubic feet of air per hour to burn one pound of pulverized coal per hour. In equipment such as disclosed herein, any unevenness in the fuel fed into the carburetor will be magnified up to 13,000 to 1 in the combustion chamber.

In Fig. 2 a somewhat modified valve 14 is shown, the valve comprising a resilient ring 14c of internal diameter equal to that of the conveyor flight 5a, said ring 14c normally being housed in

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opposed recesses 2e—3e in the contacting faces of base plate 2 and casing 3, an annular lip 3f being formed at the outer end of recess 3e to maintain the rubber ring 14c in the said recesses. The adjacent end of the ring 14c is formed with an angularly disposed resilient lip 14g of conical form, having a central opening 14h normally closely fitting the shaft 5 and disposed slightly beyond a shoulder 5x formed between the main portion of shaft 5 and an enlargement thereof which carries conveyor flight 5a, the shoulder 5x being beveled at substantially the same angle as the conical resilient lip 14g, as shown. Thus, while the valve lip 14g shown in Fig. 2 normally contacts the shaft 5 in advance of shoulder 5x, the same may yield and expand when the pulverized coal is forced by the conveyor flight 5a toward the valve 14 with sufficient pressure.

In operation

Pulverized coal is moved by the conveyor flight 5a from hopper 1 through the feed throat valve 14 into the carburetor mixing chamber A. Air under pressure from a blower or compressor (not shown) is passed into the carburetor through the air inlet pipe 4b directly into plenum chamber B, tangentially, so as to impart a swirling motion to the air in chamber B. This swirling air is passed into the mixing chamber A, first through the central hole 12b in air flow disc 12 along shaft 5, the hole 12b through which the shaft 5 passes being large enough to pass approximately one-eighth of the air in chamber B, this air blowing directly on the point where the coal emerges from under the lip of the valve 14 around the shaft 5 with enough velocity to move the coal out into the mixing chamber A as fast as it emerges. The balance of the air is directed, and its velocity increased, by the louvres 12d in disc 12 when passing into the mixing chamber A, thus giving the air within the chamber A an accentuated swirling motion. This air picks up the coal from this point of emergence from the lip of valve 14 and the thorough mixing of air and coal is achieved by the turbulence created in the mixing chamber A, the mixture of pulverized coal and air being discharged from the carburetor through the tangential outlet 3a.

I do not limit my invention to the exact forms shown in the drawings, for obviously changes may be made therein within the scope of the claims.

I claim:

1. In combination with a hopper for pulverized material, a carburetor for mixing said material at atmospheric pressure with air above atmospheric pressure, comprising a feed throat extending from the hopper into said carburetor; a shaft extending through said throat; a conveyor flight on said shaft terminating adjacent the discharge end of said throat; an annular mixing chamber in said carburetor into which the feed throat discharges; an annular plenum chamber in said carburetor contiguous to the mixing chamber; a resilient feed throat valve within the mixing chamber around the shaft; a wall in the carburetor separating the said chambers and having a means for directing air with a swirling motion into the mixing chamber, said wall having an offset central portion around the shaft directed towards the valve provided with an opening for the said shaft to provide an annular passage between the offset portion and shaft; a tangentially disposed inlet for air under pressure into the plenum chamber; and

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a tangentially disposed outlet from the mixing chamber.

2. In a combination as set forth in claim 1, said valve comprising a flat rubber disc having its periphery secured to the wall of the mixing chamber, said disc having a central opening snugly receiving the said shaft and normally closing the feed throat.

3. In a combination as set forth in claim 1, said valve comprising a rubber ring mounted in an annular recess in the discharge end of the feed throat, said ring having a conical lip provided with an opening snugly receiving the said shaft and normally closing the feed throat.

4. In a combination as set forth in claim 1, said annular passage being of area sufficient to pass approximately one-eighth of the air from the plenum chamber directly onto the valve to move the material out into the mixing chamber as fast as it emerges from the feed throat.

5. In combination with a hopper for pulverized coal, a carburetor for mixing said coal at atmospheric pressure with air above atmospheric pressure, comprising a feed throat extending from the hopper into said carburetor; a shaft extending through said throat; a conveyor flight on said shaft terminating adjacent the discharge end of said throat; an annular mixing chamber in said carburetor into which the feed throat discharges; an annular plenum chamber in said carburetor contiguous to the mixing chamber; a resilient feed throat valve within the mixing chamber around the shaft; a wall in the carburetor separating the said chamber and having an annular series of louvres therein inclined in the same direction and discharging into the mixing chamber, said wall having an offset central portion around the shaft directed towards the valve and provided with an opening for the said shaft to provide an annular passage between the offset portion and shaft; a tangentially disposed inlet for air under pressure into the plenum chamber; and a tangentially disposed outlet from the mixing chamber.

6. In a combination as set forth in claim 5; said louvres being disposed at an acute angle to the swirling movement of the air in the plenum chamber, and being of such combined area that the air volume and pressure of the swirling air in the mixing chamber will immediately remove the coal as it is discharged past the valve, the air and coal swirling within the mixing chamber before passing through said outlet.

7. In a combination as set forth in claim 5, said valve comprising a flat rubber disc having its periphery secured to the end wall of the mixing chamber, said disc having a central opening snugly receiving the said shaft and normally closing the feed throat.

8. In a combination as set forth in claim 5, said valve comprising a rubber ring mounted in an annular recess in the discharge end of the feed throat, said ring having a conical lip provided with an opening snugly receiving the said shaft and normally closing the feed throat.

9. In a combination as set forth in claim 5, the combined area of the louvres being such as to maintain a minimum air velocity within the mixing chamber of approximately 5000 feet per minute, thereby setting up an intense turbulence therein to thoroughly mix the coal with the air before passing through the outlet.

10. In a combination as set forth in claim 5,

said annular passage being of area sufficient to pass approximately one-eighth of the air from the plenum chamber directly onto the valve to move the coal out into the mixing chamber as fast as it emerges from the feed throat.

11. In combination with a hopper for pulverized coal, a carburetor for mixing said coal at atmospheric pressure with air above atmospheric pressure, comprising a feed throat extending from the hopper into said carburetor; a shaft extending through said throat; a conveyor flight on said shaft terminating adjacent the discharge end of said throat, the periphery thereof slidably engaging the walls of said throat; an annular mixing chamber in said carburetor into which the feed throat discharges; an annular plenum chamber in said carburetor contiguous to the outer end of the mixing chamber; a resilient feed throat valve within the mixing chamber around the shaft; a wall in the carburetor separating the said chambers and having an annular series of louvres therein inclined in the same direction and discharging into the mixing chamber; and said wall having a conical offset central portion around the shaft directed towards the valve and provided with an opening for the said shaft to provide an annular passage between the offset portion and shaft; a tangentially disposed inlet for air under pressure into the plenum chamber; and a tangentially disposed outlet from the mixing chamber.

12. In a combination as set forth in claim 11, said louvres being disposed at an acute angle to the swirling movement of the air in the plenum

chamber, and being of such combined area that the air volume and pressure of the swirling air in the mixing chamber will immediately remove the coal as it is discharged past the valve, the air and coal swirling within the mixing chamber before passing through said outlet.

13. In a combination as set forth in claim 11, said valve comprising a flat rubber disc having its periphery secured to the end wall of the mixing chamber, said disc having a central opening snugly receiving the said shaft and normally closing the feed throat.

14. In a combination as set forth in claim 11, said valve comprising a rubber ring mounted in an annular recess in the discharge end of the feed throat, said ring having a conical lip provided with an opening snugly receiving the said shaft and normally closing the feed throat.

15. In a combination as set forth in claim 11, the combined area of the louvres being such as to maintain a minimum air velocity within the mixing chamber of approximately 5000 feet per minute, thereby setting up an intense turbulence therein to thoroughly mix the coal with the air before passing through the outlet.

16. In a combination as set forth in claim 11, said annular passage being of area sufficient to pass approximately one-eighth of the air from the plenum chamber directly onto the valve to move the coal out into the mixing chamber as fast as it emerges from the feed throat.

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No references cited.