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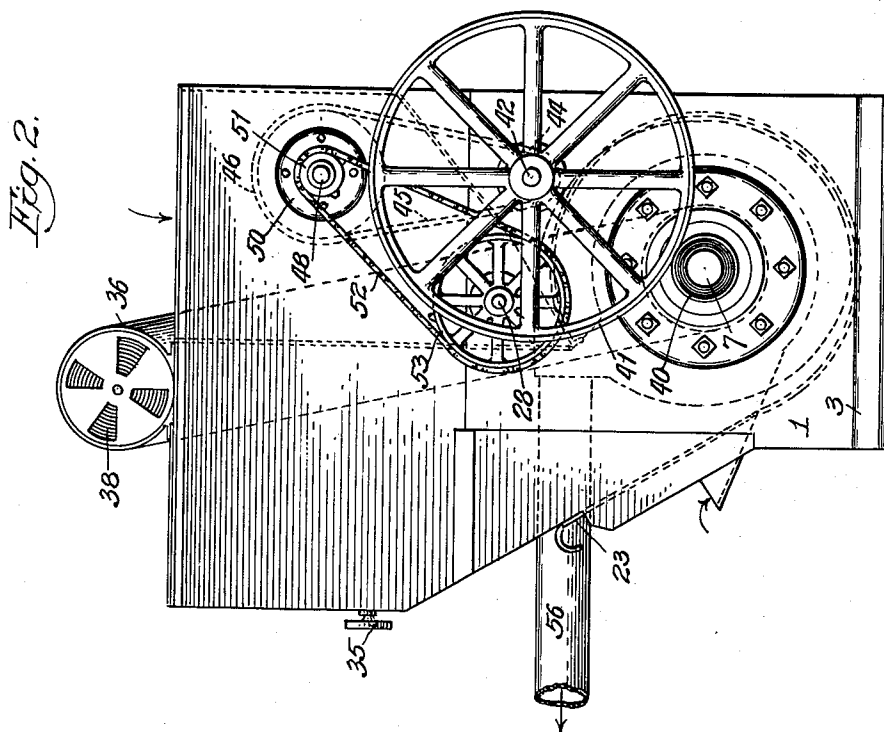
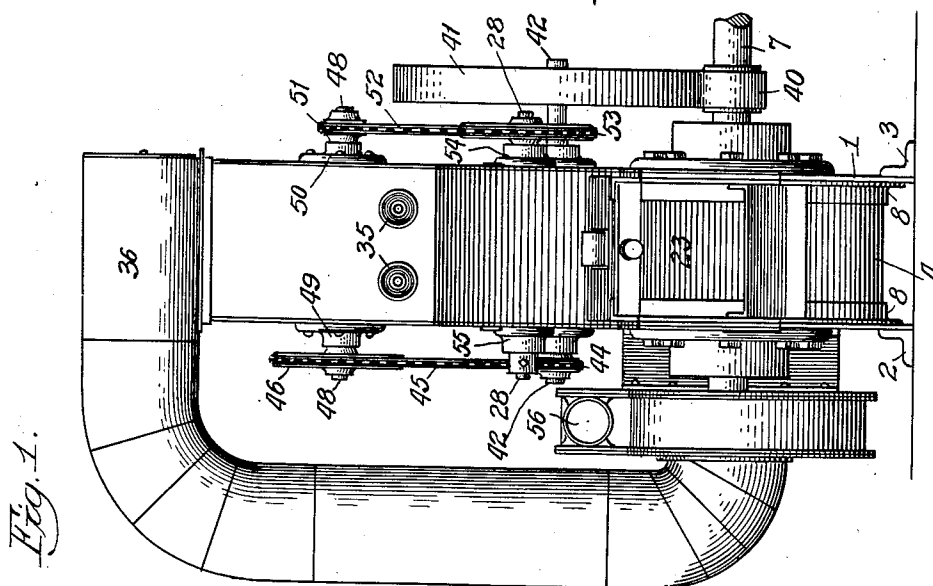
H. G. LYKKEN

1,793,705

FUEL DEVICE

Filed Feb. 23, 1924

2 Sheets-Sheet 1



Inventor:
Henry G. Lykken,
by Wallace R. Lane.

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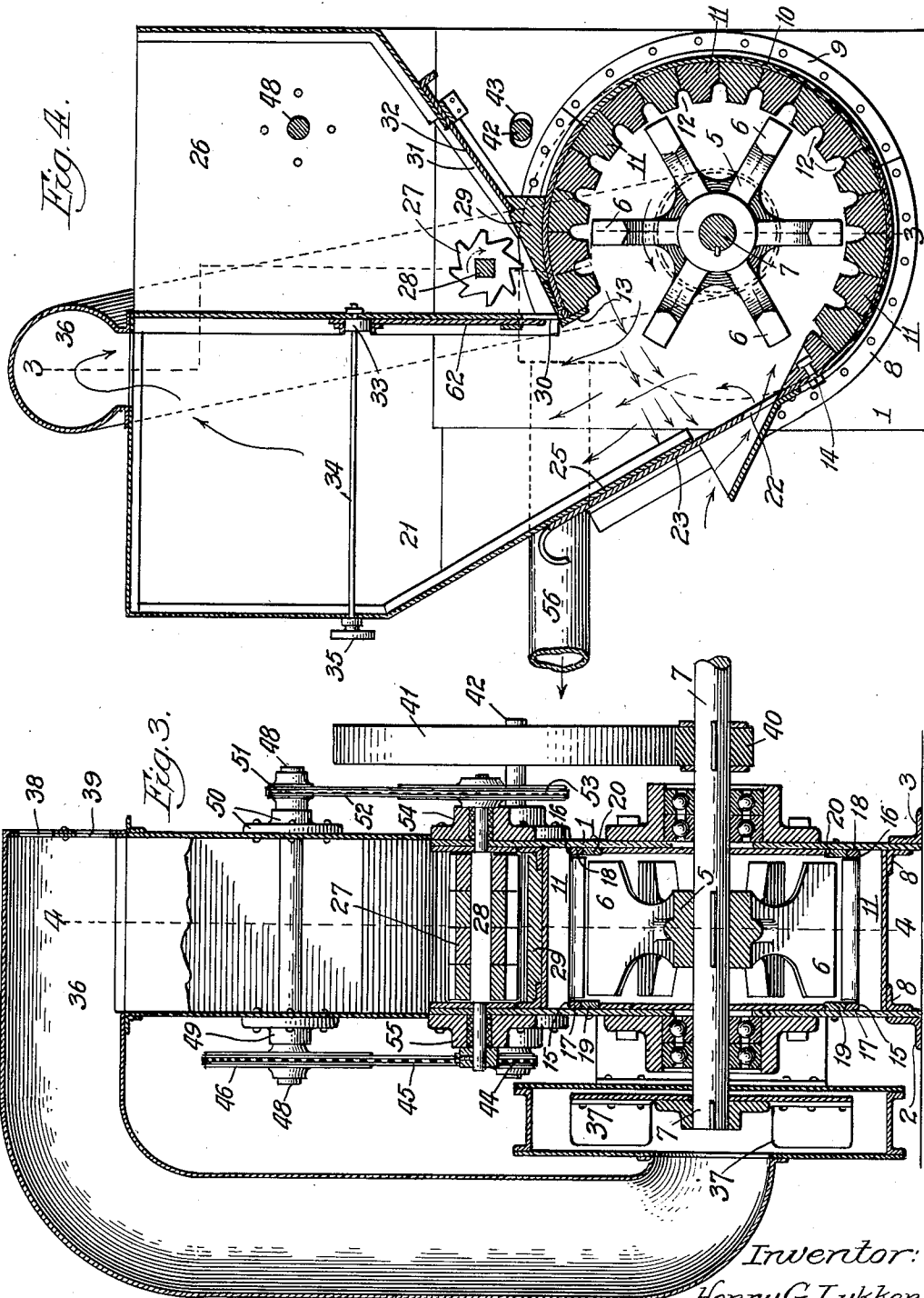
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FUEL DEVICE

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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

HENRY G. LYKKEN, OF MINNEAPOLIS, MINNESOTA

FUEL DEVICE

Application filed February 23, 1924. Serial No. 694,460.

The present invention relates to devices or apparatus for supplying fuel of more or less fluidal or pulverized character to a place of combustion.

5 Among the objects of the invention are to provide a device of the character described for grinding or pulverizing fuel to a given fineness and separating out the finer particles of the fuel and conveying the same to a point of use or combustion; to provide for a novel means for crushing the fuel to a given size, preferably by a crusher roll which will act to break the lumps of fuel to a given maximum size, such as one inch, to agitate the fuel when crushed so that it will be well mixed and prepared for the grinding operation, and for aiding in feeding the fuel to the grinding portion of the device, and also, depending upon the rate of operation of the crusher roll, to act as a measuring device for the fuel being fed to the grinding mechanism; to provide a control device, such as a gate, for controlling the feed to the grinding device and to operate the control device by suitable means, such as manually operated cams, for adjusting the gates to the desired height; to provide for controlling or regulating the degree of fineness or separation of the pulverized fuel as desired or as proper combustion may require; to provide a novel form of grinding means or material reducer capable of grinding or pulverizing the fuel into a fine space and of giving the ground fuel a path of movement through a current or stream of air or other fluid whereby the fine particles of the fuel may be separated from the heavier particles; to provide such grinder with means to receive the projected or dashed ground fuel so as to thoroughly stir up the ground particles whereby the separation of the finer particles therefrom may be facilitated; to provide for the adjustment or taking up of grinding parts of the grinding mechanism to compensate for wear and the like; to provide for the easy removability and replacement of such parts; to provide removable means, such as a breaker block in cooperation with the crusher roll, for efficiently crushing the fuel to the desired size and for removing the breaker

block when the same is worn and needs replacing; to provide a receptacle for the fuel in which the crushing operation may be carried out and with openings whereby easy access may be had to the crushing mechanism for the cleaning thereof and the removal of non-crushable material and also the removal and replacing of the crusher blocks; to provide for removability and renewal of parts of the grinder by making the grinder with a removable section to permit access in the interior of the grinder, such access also being of avail for cleaning the interior of the grinder; to provide for separation of the finer particles of the fuel by the use of an air blast or stream preferably in the grinder itself or so located that the stream of air will pass through the path of the ground fuel as it is projected from the grinder or the rotor thereof; to provide for the creation of a partial vacuum within the device so as to cause or induce the air stream mentioned; to provide for regulating the amount and force of the air blast or stream; to provide a common means for receiving the dashing of the ground fuel and for controlling the opening of the air inlet to the grinder; to provide a chamber in which the air and finer particles may expand so that the two may be thoroughly mixed for uniform combustion; to provide for the introduction of additional supporter of combustion to the expanded fuel whereby proper combustion may be obtained at the point of use; to provide for a friction drive of the crusher roll whereby if the latter is clogged by non-crushable material the drive will be capable of slipping and preventing destruction of the mechanism and also to give the operation of the parts a more even action; to provide other means for preventing destruction of the crushing mechanism, preferably in the form of a shear pin in the drive to the crusher mechanism; and to provide for such other objects, advantages and capabilities as will hereafter appear and are inherently possessed by the invention.

In the drawings showing one form of device constructed in accordance with the invention, Fig. 1 is an end view in elevation; Fig. 2 is a side view in elevation; Fig. 3 is

a vertical transverse sectional view; and, Fig. 4 is a vertical longitudinal sectional view of the device and taken on the line 4—4 of Fig. 3.

Referring more particularly to the drawings, the device is shown as comprising a support 1 having feet 2 and 3 and connected to a reducing chamber 4 in which is located a rotating member or rotor 5 having radially projecting hammer arms 6 secured to a drive shaft 7 extending horizontally through the casing 4. The wall of the casing is substantially circular in form and is connected to the side walls of the support by means of angle members 8 and 9. Part of the casing wall is permanently secured in place and part is removable and is in the form of a section 10 as clearly shown in Fig. 4 of the drawings. Against the inner wall of the casing is placed a series of grinding or reducing elements 11 each formed with cut out portions which form between the pairs of the grinding elements concaves or recesses 12 for holding part of the fuel while the hammers operate thereon to grind the fuel. The outer ends of the hammers 6 are spaced from the inner ends of the elements 11 as shown in Fig. 4 of the drawings. The grinding elements are arranged in a three-quarter circle series with one end of the series abutting against an abutment member 13 and at the other end having an end element secured to the casing wall by suitable bolts 14. Each grinding element is provided at the ends thereof with shoulders 15 and 16 against which are placed arc shaped retaining bars 17 and 18 insertable through the openings of the grinder when the section 10 is removed. These bars are interposed between segmental bars 19 and 20 secured to the inner side walls of the casing. In the event of the grinding elements becoming worn and reduced in length, they may be moved radially inward to within a given distance of the ends of the hammers 6 by removing the bars 17 and 18 and inserting, in place thereof, narrower bars, and at the same time placing shims between the rear ends of the grinding elements and the inner wall of the casing.

In the quarter of the circle between the ends of the series of grinding elements is a passage for the discharge of the ground material into a chamber 21 which constitutes the expansion chamber for the fuel after it has been ground and separated. At one side of the grinder or reducer is provided an opening through which air may be let in, in the direction shown by the arrows, into the interior of the grinder for the purpose of separating out the finer particles of fuel being ground. This inlet opening 22 may be controlled or varied by a slide plate 23 having a handle 24 by which it may be manually operated to vary the inlet. This slide plate 23 together with a wall portion 25 of the passage between the grinder and the expansion

chamber act as a dash plate against which the ground fuel may be hurled or projected from the hammers of the rotor as shown by the arrows directed toward this space, as clearly shown in Fig. 4 of the drawings. The entry of the air and its movement upwardly through the passage will also be through the stream of fuel being thus dashed and will pneumatically separate out the finer particles of the fuel and convey them into the expansion chamber.

Above the grinding mechanism is provided a hopper 26 in which the fuel is initially placed to be prepared for grinding. Within this hopper, near the lower portion thereof, is a rotary crusher roll 27 carried upon a cross-shaft 28 extending through the side walls of the hopper and operated by suitable driving mechanism hereinafter described. The crusher roll has a set of teeth extending serially in the same direction and is located in given spaced relation with respect to a breaker block 29 located in the bottom of the hopper. The roll and breaker block are so spaced that it may crush the fuel to a given maximum size, as for example one inch in size. The teeth of the roller also direct it in a direction so that they will aid in feeding the fuel downwardly toward the discharge opening 30 of the hopper. The hopper is also provided with an opening 31 adjacent the breaker block 29 and may be closed by a slide plate 32. This opening is of utility for giving access to the interior of the hopper for cleaning the crusher roll and for removing non-crushable matter such as pieces of iron and stone. It also is useful in permitting the removal of the breaker block when it is worn and needs replacing. The discharge opening of the hopper is controlled by a slide gate 32 which may be vertically slidable by means of cams 33 operating in suitable recesses formed in the slide gate and connected to operating rods 34 extending exteriorly of the expansion chamber and provided with hand wheels 35. By rotating the cams 33 the height of the gate may be adjusted as desired to control the amount of fuel fed from the hopper through the opening 30 and into the chamber of the grinder.

After the fuel has been separated and conveyed into the expansion chamber it may then proceed into a conveying conduit 36 proceeding to the inlet of a fan blower or air flow inducer 37, the fan blades of which are mounted upon the ends of the shaft 7. It will be observed here that the shaft is common to both the rotor of the grinder and the fan of the blower or inducer. This fan creates a suction or partial vacuum which is effective in the expansion chamber and in the grinding mechanism so as to draw in a current of air through the inlet port 22 of the grinder. In this way the air stream or blast is created. The conduit 36 may be pro-

vided with air inlet openings 38 controlled by vanes 39 capable of regulating the amount of inflow of fresh air or other supporter of combustion.

5 The driving mechanism for the crusher comprises a friction pinion 40 keyed to the shaft 7 and in driving engagement with a friction pulley 41 secured to a cross-shaft 42 extending through suitable elongated aper-
 10 tures 43 provided in the side walls of the device. On the other end of the shaft 42 is secured a sprocket 44 in driving engagement with a chain 45 operating over a sprocket wheel 46 secured to an end of a cross-shaft 48 supported in bearings 49 and 50 fastened
 15 to the side walls of the exhaust chamber. To the other end of this shaft 48 is secured a sprocket 51 operating with a chain 52 passing over a sprocket wheel 53 fastened to one end of shaft 28, the latter being supported in bearings 54 and 55 attached to the side walls
 20 of the hopper. By this means there is a great reduction of speed but increase of power delivered to the crushing roll. In order that the crusher may not act to destroy the device when it attempts to operate upon non-crushable material such as pieces of
 25 metal, stone and the like, the pulley 41 is secured to the shaft 42 with a shear pin which will be capable of breaking or shearing at a given load point, thus preventing the destruction of the apparatus. After removing the non-crushable material a new shear pin may be secured in place and the
 30 device again operated.

35 The fuel after leaving the fan blower is discharged through a conduit 56 leading to the combustion chamber of a furnace or the like where the fuel undergoes combustion.

40 In operation, the fuel is placed in the hopper 26 and is operated upon by the crusher roll to break it to sufficiently small size to be operated upon by the grinder. The fuel is then forced downwardly by the teeth of the crusher roll and fed through the opening 30
 45 into the grinder. The crusher roll 27 is designed to operate upon and feed a larger amount of crushed fuel than can be controllably fed through the opening 30, the excess of crushed material passing back in the
 50 hopper space above the roll 27. In the grinder the fed material will be operated upon by the hammers and the grinding elements to reduce its size and be projected with force by the hammers against the dash plate
 55 25 and 23 so that it will be thoroughly stirred for action thereupon by the air blast. In the meanwhile the blower has created a partial vacuum in the expansion chamber and in the passage between it and the
 60 grinder so as to induce or draw in a stream of air through the inlet openings 22 and upwardly through the path of projection of the fuel from the hammers.
 65 This stream of air will separate out the finer

particles and carry the same into the expansion chamber where the mixture may expand and the flow of the mixture be made more uniform. The mixture may then be drawn into the passage 36 where incoming fresh air may be mixed therewith so as
 70 to have proper combustion proportions and then pass into the blower where it is further conveyed to the conduit 56 to the place of combustion.

75 While I have herein described and upon the drawings shown a preferred form of the invention, it is to be understood that the invention is not limited to the particular construction, details and arrangement of parts described and shown, but that it compre-
 80 hends other constructions, details and arrangements of parts without departing from the spirit thereof.

85 Having thus described my invention, I claim:

1. In an apparatus of the character disclosed, a common means for crushing fuel below a given size and for feeding the crushed fuel to be ground, means for grinding
 90 the crushed fuel to a given fineness, and means for creating a stream of air transversely to the path of projection of the grinding means, said grinding means operating to project the ground fuel into said stream of air
 95 for pneumatically separating out fine particles of fuel.

2. In an apparatus of the character disclosed, a common means for crushing fuel below a given size and for feeding the crushed fuel to be ground, means for grinding the
 100 crushed fuel to a given fineness, and means for creating a partial vacuum in said grinding means whereby a current of air moving transversely to the path of projection of the grinding means may be effected for separating the
 105 finer particles of fuel from the ground fuel, said grinding means being provided with an air inlet.

3. In an apparatus of the character disclosed, a common means for crushing fuel below a given size and for feeding the crushed fuel to be ground, means for grinding the
 110 crushed fuel to a given fineness, means for creating a partial vacuum in said grinding means whereby a current of air moving transversely to the path of projection of the grinding means may be effected for separating the
 115 finer particles of fuel from the ground fuel, said grinding means being provided with an air inlet, and means for varying the size of said inlet.

4. In an apparatus of the character disclosed, a hopper for fuel, a discharge outlet for the fuel, a rotary crusher roll in the hopper and having teeth thereon for crushing
 120 the fuel and for forcing the fuel toward the discharge outlet, a breaker plate cooperating with the roll for the crushing of the fuel between the surface of said plate and the roll,
 125

reducing means, and separating means, said outlet discharging through said separating means into said reducing means.

5 5. In an apparatus of the character disclosed, a grinder comprising a discharge opening and grinding elements, a rotor co-
operable therewith for grinding fuel to a
10 powder, an air inlet for admitting air into the grinder and for creating a stream of air through the discharge opening, a slidable
plate for controlling the size of the inlet,
said plate being normally positioned to oper-
ate as a dash plate for the fuel cast from the
rotor whereby the fuel is agitated and the
15 stream of air separates therefrom the finer particles and conveys them to a point of use.

6. In an apparatus of the character disclosed, a grinder comprising a chamber,
grinding elements arranged on the inner
20 wall of the chamber, a rotor cooperating with the elements for grinding fuel to a powder,
said chamber and elements having oppos-
ing shoulders, removable means of selected
thickness interposable between said shoul-
25 ders for holding the elements at given dis-
tances from the rotor, and shims between said
elements and the chamber wall for holding
the elements at the given distances from the
rotor.

30 7. In an apparatus of the character disclosed, a grinder chamber having a removable
section for affording access to the interior of
the chamber, a rotor in the chamber, grind-
ing elements around the rotor and spaced
35 therefrom at a predetermined distance, spac-
ers for holding the elements at said distance,
and means for holding the elements in place.

8. A material reducing device comprising
a pulverizing means having an opening
40 through which material to be reduced enters
into said means and through which pulver-
ized or reduced material is discharged, a ma-
terial holder having a discharge means for
supplying material to be reduced to and
45 through said opening, a separating chamber
having an inlet coinciding with said open-
ing, and means for admitting a stream of air
so as to project said air transversely through
the projected reduced material in said open-
50 ing.

9. A material reducing device comprising
a pulverizing means having an opening
through which material to be reduced enters
into said means and through which pulver-
55 ized or reduced material is discharged, a ma-
terial holder having a discharge outlet ad-
jacent one edge of said opening, so as to
supply material to be reduced to and through
said opening, a separating chamber having
60 an inlet coinciding with said opening, and
means for projecting a stream of air trans-
versely through the projected reduced ma-
terial in said opening, the reducing cham-
ber having an air inlet in the front wall
65 thereof proximate to said opening for direct-

ing a stream of air transversely to the pro-
jected reduced material in said opening.

10. A unitary construction comprising a
common motive element adapted to be oper-
ated from a motive source, means associated
70 with said motive element and operated by the
latter for reducing material to a fine state, a
flow inducing means separate from said re-
ducing means but associated with said motive
element to be operated thereby for inducing
75 a flow of reduced particles in suspension in
a fluid stream, and a classifying means
higher than said reducing means and con-
nected to said reducing means and said in-
ducing means and through which the re-
80 duced particles in suspension flow from the
reducing means to said inducing means,
said classifying means operating to separate
out fine particles and to return the larger
particles to the reducing means for re-reduc-
85 tion.

11. A unitary construction comprising a
material reducer, an air flow inducer, a com-
mon shaft associated with said reducer and
said inducer for operating the same, a pas-
90 sage from the reducer to the inducer, and
means higher than said reducing means and
associated with said passage for separating
finer from coarser particles of reduced ma-
terial moving in said passage.
95

12. A unitary construction comprising a
material reducing device, a fan, a shaft ex-
tending through said reducing device and
said fan for operating the same, and a clas-
sifying device higher than said reducing de-
vice and connected with the outlet of the re-
ducing device, and the inlet of the fan for
separating fine particles from coarser par-
ticles of reduced material.

13. A fuel device of the character de-
scribed comprising means for grinding the
fuel, a hopper, a rotatable feed device for de-
livering fuel to the grinding means, fixed
crusher means located within said hopper and
cooperating with said rotatable feeding de-
110 vice for preliminarily crushing the fuel as it
is fed, and means for controlling the rate of
feed to said grinding means.

14. A fuel apparatus of the character de-
scribed comprising a grinding chamber hav-
115 ing a longitudinally disposed fuel opening
and also an air inlet independent of said
fuel opening, means for feeding fuel to said
pulverizing chamber through said fuel open-
ing, a passage for conducting fuel from said
120 material opening to a place of use, said pas-
sage having means for causing an air stream
to flow successively through the air inlet and
said fuel opening, a rotatable pulverizer in
said chamber positioned laterally with re-
125 spect to said fuel opening so as to be located
to one side of the path of travel of said air
stream, said pulverizer having centrifugal
means for projecting a stream of pulverized
fuel into said air stream.
130

15. A fuel apparatus of the character described comprising a grinding chamber having a longitudinally disposed fuel opening and also an air inlet independent of said fuel opening, means for feeding fuel to said pulverizing chamber through said fuel opening, a passage for conducting fuel from said fuel opening to a place of use, said passage having a portion positioned adjacent to said grinding chamber, a suction device in the last mentioned portion of said passage for causing an air stream to flow successively through the air inlet and said fuel opening, a rotatable pulverizer in said pulverizing chamber positioned laterally with respect to said fuel opening so as to be located to one side of the path of travel of said air stream, said pulverizer having centrifugal means for projecting a stream of pulverized fuel into said air stream, and a common shaft for said pulverizer and said suction device.

16. In an apparatus of the character described, a grinder for fuel, a separating chamber joined to the upper portion of the grinder, means for introducing a stream of air at the front of the grinder so as to cause said air to pass transversely through the ground fuel to separate the finer particles therefrom and to convey them into said chamber, and means for drawing air out of the upper portion of said chamber so as to convey a mixture of fuel and air to the location of consumption.

17. In an apparatus of the character described, a grinder for fuel, a separating chamber joined to the upper portion of the grinder, means for introducing a stream of air at the front of the grinder so as to cause said air to pass to travel transversely through the ground fuel to separate the finer particles therefrom and to convey them into said chamber, means for creating a partial vacuum in said chamber, means for conveying the mixture of air and particles into the chamber to a point of use, and means for admitting additional air to the last mentioned means.

18. A material reducing device comprising a reducing chamber having end and side walls and having an opening in the upper part thereof, a hopper having its outlet adjacent to one edge of said opening, a rotatable crusher member within said hopper having means for feeding material through said outlet into said chamber by way of said opening, reducing means in the chamber operative to project reduced material across said opening, the chamber having an air inlet in the front wall thereof approximate to said opening for directing a stream of air transversely to the projected reduced material in said opening, and a regulating gate for said air outlet.

19. A fuel pulverizer and stoker having a grinding chamber and a superposed separat-

ing chamber joined thereto, a fuel feed hopper having its lower end provided with a discharge opening located at the junction between said chambers, and means for exhausting air out of the upper portion of said separating chamber, the front wall of said grinding chamber having an air inlet therein at a position below the junction between the chambers so that a stream of air will be aspirated through the ground fuel.

20. A fuel pulverizer and stoker having a grinding chamber, a separating chamber above and joining the grinding chamber, a fuel feed hopper opening into the junction between said chambers, means for introducing air into the grinding chamber through the front wall thereof, at a position below the junction between said chambers, and means for exhausting the air out of the upper portion of said separating chamber.

21. In an apparatus of the character described, a grinder for fuel, an expansion chamber joined to the upper portion of the grinder, means for introducing a stream of air at the front of the grinder so that said air will pass transversely through the ground fuel to separate the finer particles therefrom and convey them into said chamber, and means for drawing air out of the upper portion of the chamber for carrying air and fuel mixture to the location of consumption.

22. In a fuel stoking device, a grinding chamber, a grinder therein, a hopper having its discharge opening communicating with said chamber, a stationary crusher member located in said hopper over said grinder, a rotatable crusher member also located in the lower part of said hopper over the stationary crusher member, means for creating a current of air through said chamber so as to mix fuel and air and to convey the mixture to the place of consumption, and independently operable means regulating the discharge from said hopper and the admission of air respectively, so as to control the relative proportions of the mixed air and fuel.

In witness whereof, I hereunto subscribe my name to this specification.

HENRY G. LYKKEN.