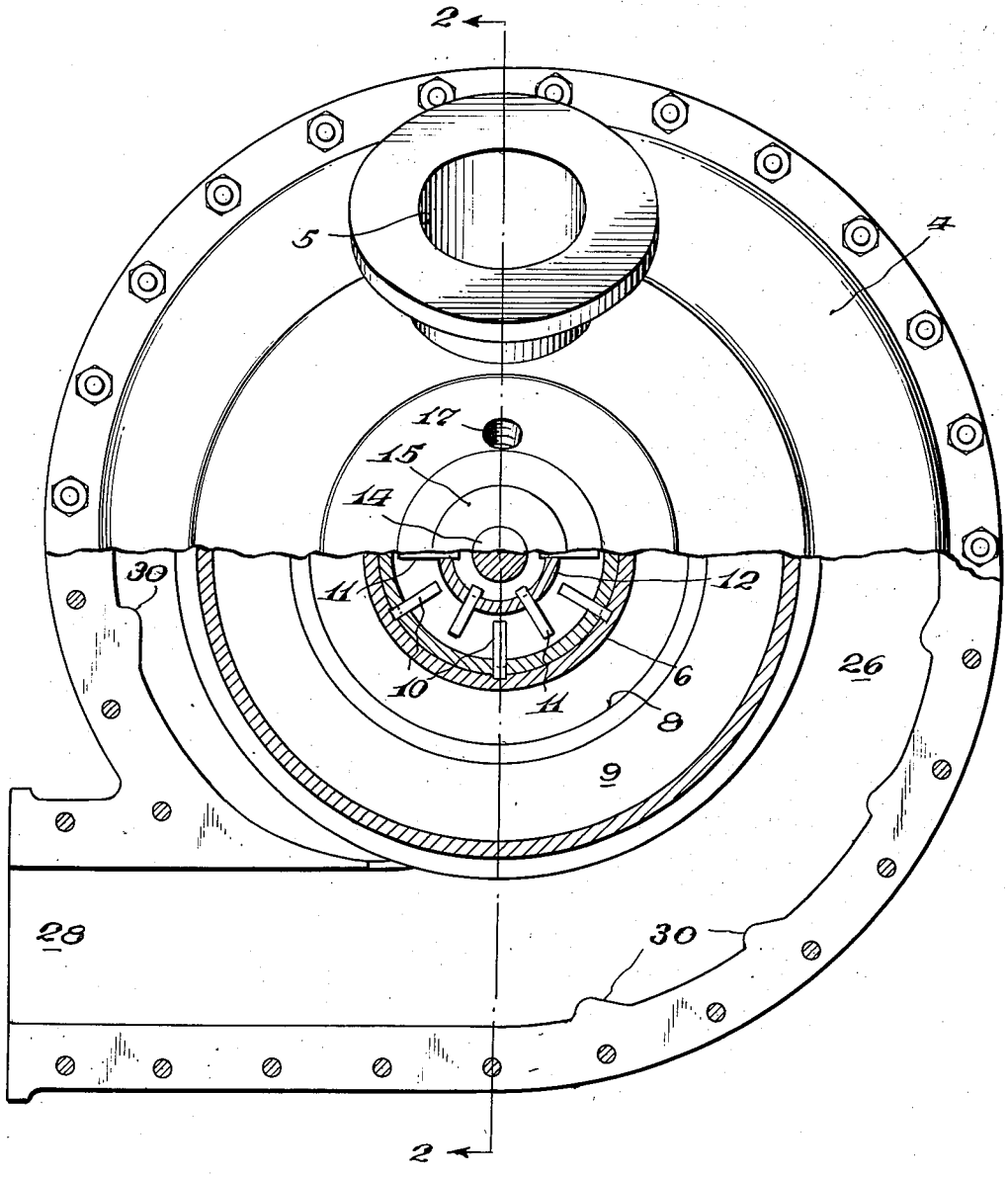
Feb. 5, 1952 R. F. LEFTWICH 2,584,805

METHOD AND APPARATUS FOR PRODUCING AN EMULSION, INCLUDING WATER, FUEL OIL, AND FINELY DIVIDED SOLIDS FOR COMBUSTION

Filed July 18, 1945 3 Sheets-Sheet 1

Fig. 1



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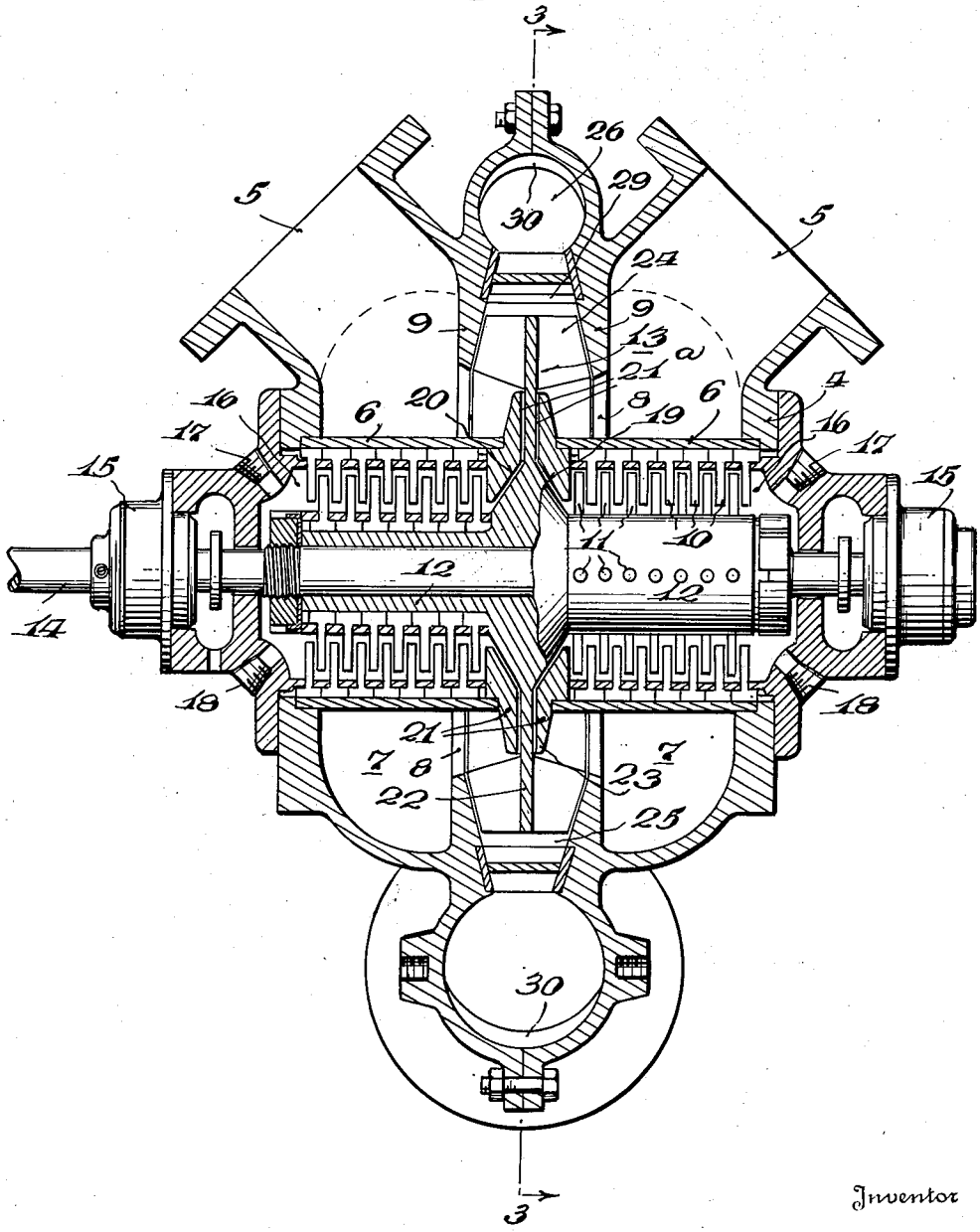
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Filed July 18, 1945 3 Sheets-Sheet 2

Fig. 2



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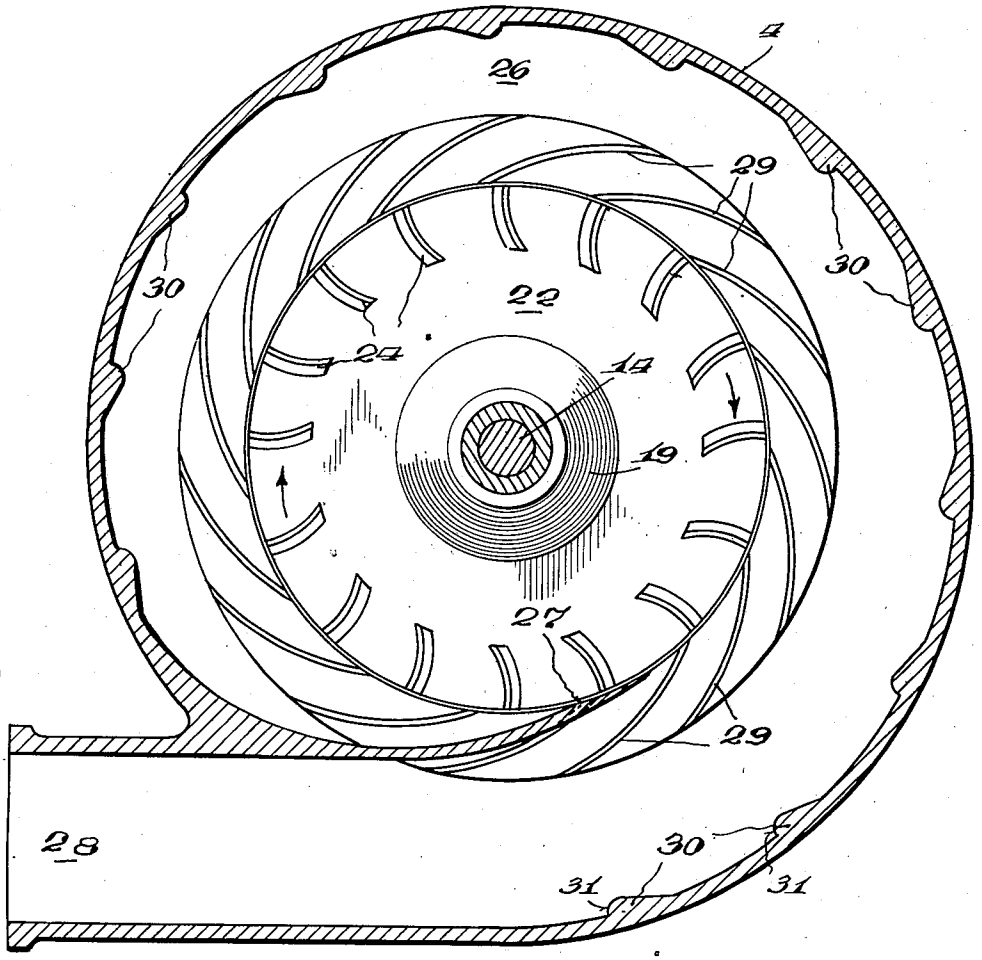
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Filed July 18, 1945 3 Sheets-Sheet 3

Fig. 3



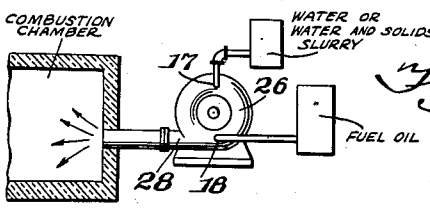


Fig. 4.

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METHOD AND APPARATUS FOR PRODUCING AN EMULSION, INCLUDING WATER, FUEL OIL, AND FINELY DIVIDED SOLIDS FOR COMBUSTION

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Application July 18, 1945, Serial No. 605,813

4 Claims. (Cl. 60—39.05)

1

This invention relates to a method of and apparatus for burning liquid fuels in the presence of finely divided solids, such as coal or the like, Portland cement or other raw materials.

An object of the invention is to supply controlled heat for chemical and metallurgical processing of finely divided solids.

Another object is to provide improved means to facilitate the operation of gas turbines by colloidal fuels.

In either of these cases, as in many others which it is unnecessary to enumerate and describe, I can by my improvements carry on any desired degree of burning to generate heat, or chemical or metallurgical reactions, where temperature limitations are important.

The characteristics and advantages of the present invention are further sufficiently explained in connection with the following detailed description of the accompanying drawings, which show a certain representative embodiment. After considering this example, skilled persons will understand that many variations may be made without departing from the plans disclosed, and I contemplate the employment of any structures that are probably within the scope of the appended claims.

Referring to the drawings:

Fig. 1 is a side elevation partly broken away and in section.

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

Fig. 3 is a vertical sectional view on the line 3—3 of Fig. 2.

Fig. 4 is a diagrammatic side elevational view partly in section and on a smaller scale showing the general organization of apparatus for carrying out the invention.

Referring to the drawings, 4 designates a casing provided with a plurality of inlets 5 for the introduction of a suitable oxygen containing gas, such as air, into the apparatus. Within the casing there is a pair of stationary tubes 6 forming the inner walls of annular chambers 7 from which the air or the like is discharged through annular throats 8 surrounded by the inner edges of annular internal walls 9 of the casing. Within the tubes 6 any preferred mixing means is arranged and it may consist of stationary radial fingers or blades 10 which cooperate with other blades 11 projecting radially from the hub portions 12 of a rotor 13. The latter is fixedly mounted on a rotary shaft 14 journalled in bearings 15 at opposite ends of the casing, and the shaft is driven by any suitable prime mover (not shown).

2

The tubes 6 and hub portions 12 provide annular spaces 16 having fuel inlets 17 and water inlets 18. Fuel oil, for example, and water are pumped into these inlets respectively in any suitable proportions by a variable proportioning pump of any preferred type, and in travelling between the tubes 6 and the rotor hubs, the water and fuel oil are finely dispersed one within the other by means of the blades 10 and 11. The emulsion thus formed is organized into annular flaring film-like streams by frusto-conical surfaces 19 at the medial portion of the rotor, which surfaces are arranged in close proximity to corresponding surfaces 20 provided by stationary rings 21 fixed at the inner ends of the tubes 6. The emulsion which is forced between surfaces 19 and 20 is discharged through substantially parallel annular slits 21a formed by the web 22 of a fan wheel of the rotor and projecting flanges 23 of the rings.

Immediately the emulsion travels outwardly from the ends of the flanges 23, it is cut by curved blades 24, fixed to the opposite sides of the wheel, at the time when it is mixed with the air or the like which enters the annular chamber 25 (in which the periphery of the wheel rotates) through the throats 8, so the emulsion is immediately finely divided and intermixed with the air.

As may be seen from Fig. 2, the confronting surfaces of the walls 9 and the adjacent edges of the blades 24 converge toward a scroll shaped chamber 26.

From the foregoing it will be understood that the liquid and solid materials supplied under pressure from the proportioning pump will be emulsified in the dispersion mills (10, 11) and will be forced through annular openings and distributed uniformly over the surface of the fan wheel web 22. The construction is such that the flow of liquid is restricted sufficiently to cause uniform distribution over the opposite surfaces of the web so that the emulsion will be picked up by the fan blades 24. In other words, the guiding surfaces will present uniform films of emulsion which will be sliced into infinitesimal particles and dispersed by the inner edges of the fan blades. The air for combustion entering the fan housing at 5 and in accordance with the fan action, is carried through the fan inlet and into the blades 24 in a manner which will be obvious. The action of the blades in cutting into the films of the emulsion being forced out at the outer edges of the flanges 23 and the tendency of these small particles to be thrown out by the high velocity of the revolving disc, will cause fine dispersion of emulsi-

ed fuel oil, water and the solids (if introduced nto the spaces 16) to take place within the treams of air being pumped by the fan.

In order to carry this dispersion of liquids and olids within the gas to the point at which they ill be burned or processed, I have adopted the croll 26 which has its cut-off point at 27 (Fig. 3). t gradually increases in cross-sectional area ra- lially from the center of the wheel so that a uni- orm velocity is maintained from the cut-off 27 p to the discharge opening 28. Around the inner eriphery of the scroll is a series of stationary anes 29 designed to direct the mixture along the esultant of the radial velocity and peripheral elocity producing minimum resistance to low of the fluid. These vanes serve to distribute he fluid in such a way that the velocities are naintained throughout the periphery of the fan. his construction has been designed as a means f taking advantage of the pressure velocity pro- uced by the fan in order to carry the dispersion f emulsion in combustion air, for example, to a oint remote from the burner where burning or rocessing takes place.

As a further means of maintaining thorough ispersion and prevention of segregation I have esigned a construction which produces Venturi hroats at intervals around the periphery of the croll. This includes spaced ridges or internal umps 30 so constructed and distributed as to orce the fluid stream to change its direction from ne travelling away from the fan wheel and reate throats between the outer edges of the dis- harge vanes 29 and the ridges which increases he velocity and creates a suction at the trailing nds 31 of the ridges whereby any material tend- ng to accumulate as a result of centrifugal force n the inner surface of the scroll will be sucked ff and drawn into the advancing stream.

The design of the scroll is such that the veloc- ty of gas is in the neighborhood of 290 feet per econd which is the resultant velocity created by he periphery velocity of the fan and the radial elocity of air through the blades 24. Since lame propagation is in the neighborhood of 80 eet per second, it is safe to assume that with his velocity, a safe distance can be maintained y the generation of fuel and air dispersion and he flame in the combustion or processing cham- ber (not shown). This distance between the ource and point of burning can be varied by arying the velocity of the air or gas. This par- icular velocity of 290 feet per second will afford a 9 foot space between the source of dispersion f the emulsion into the combustion air and the oint at which burning takes place and, there- fore, the high temperatures created will not be detrimental to the burning equipment.

By utilizing such apparatus I can produce an emulsion consisting of water and non-combus- tible solid minute particles, surrounded by a film f oil, and such emulsion will be uniformly dis- persed or broken into fine particles, within suf- ficient air for complete combustion of the fuel. By bringing the non-combustible matter which is to be processed or disposed of in intimate con- tact with the fuel and then in turn bringing the emulsion in intimate contact with sufficient oxy- gen for complete combustion I can produce and maintain a critical mixture which will result in combustion at its maximum efficiency.

It is appreciated that prior apparatus has been proposed whereby air has been supplied to fuel prior to introduction into the combustion cham- ber but I offer a novel method of accomplishing

this in such a way as to maintain this critical mixture in perfect dispersion until it is delivered to the place in the furnace where combustion or processing takes place.

By this method and apparatus I am able to bring about an intimate association between fuel and non-combustible solid particles, for exam- ple, at the place where processing is to be accom- plished and such processing will take place at maximum efficiency while the solids are in sus- pension and in a state of maximum dispersion.

In addition to my ability to bring finely divided solid matter into intimate association with fuel and air so that processing and combustion take place simultaneously and at maximum efficiency, I am permitted to use such varying quantities of non-combustibles and water that I can control the degree of processing to prevent it from going beyond a desired point, which is obviously of great advantage in calcining before clinkering in the manufacture of Portland cement, for ex- ample. Going one step beyond this, I offer this process as a means of drying materials by burn- ing fuel in direct contact with water contained in the materials without burning or processing the materials beyond the drying stage.

The method and apparatus can also be em- ployed efficiently in generating steam by burning fuel in direct contact with water.

It will be obvious that the amount of water employed in these various processes can also be increased to the point where it will act as a lim- iting factor in the production of heat.

Although the invention has been illustrated and described as including a dispersion mill con- structed as an integral part of the burner, those skilled in the art will recognize that the emulsion of oil and water, or oil, water and finely divided solids, can be made in a dispersion mill inde- pendently of the burner, and such emulsion can be dispersed in air or other gas by means of the parts arranged posteriorly of the tubes 6. I also propose to produce a colloidal fuel in accordance with the method disclosed in my application, Se- rial No. 505,603, filed October 5, 1943, now aban- doned, and to mix it with air by the apparatus of the present application before utilizing the com- bustible mixture in a gas turbine or the like.

The apparatus should be especially useful in producing colloidal fuels if the finely divided solids are combustible.

I claim:

1. A method comprising producing an emul- sion including water, fuel oil and finely divided solids and in which the fuel oil is present in suffi- cient amount to furnish heat for the processing of the solids when the fuel oil is burned, pass- ing such emulsion in a thin annular film radially outward from a center, then cutting the film into a number of streams while projecting the streams centrifugally away from said center, intimately mixing a combustion supporting gas with said streams immediately they are formed, after- wards organizing the streams into a common stream and causing said common stream to travel scroll fashion, and subsequently subjecting the common stream to combustion at a point re- mote from that where it travelled scroll fashion.

2. A method as claimed in claim 1 in which the common stream is caused to alternately ex- pand and contract while travelling scroll fashion.

3. In apparatus for processing and feeding liquid fuels to a zone of combustion, a stationary casing, a fixed tube mounted within said casing forming the inner wall of an annular chamber

within the casing, means within the tube for mixing fuel oil and water into an emulsion, a rotatable hub within and at one end of the tube, means carried by the tube and by the hub forming an annular slit adjacent one end of the tube through which the emulsion moves as a film, a disc-shaped web carried by said hub for receiving the film passing through said slit, a plurality of circumferentially spaced blades carried by a peripheral portion of said web, said casing having an air inlet opening for admitting air into said chamber and into the presence of said blades, and a scroll member arranged around the casing outwardly of said web.

4. In apparatus for processing and feeding liquid fuels to a zone of combustion, a stationary casing, a tube mounted within said casing forming the inner wall of an annular chamber within the casing, means within the tube for mixing and agitating fuel oil and water into an emulsion, a rotatable hub within the tube, means carried by the tube and the hub forming an annular slit through which the emulsion moves as a film, a disc-shaped web carried by said hub for receiving the film passing through said slit, a plurality of circumferentially spaced blades carried by a peripheral portion of said web, said casing having an air inlet opening for admitting air into said chamber and into the presence of said blades, a scroll arranged around the casing outwardly of said web, and means within the scroll providing throats altering the cross sectional area of the scroll.

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