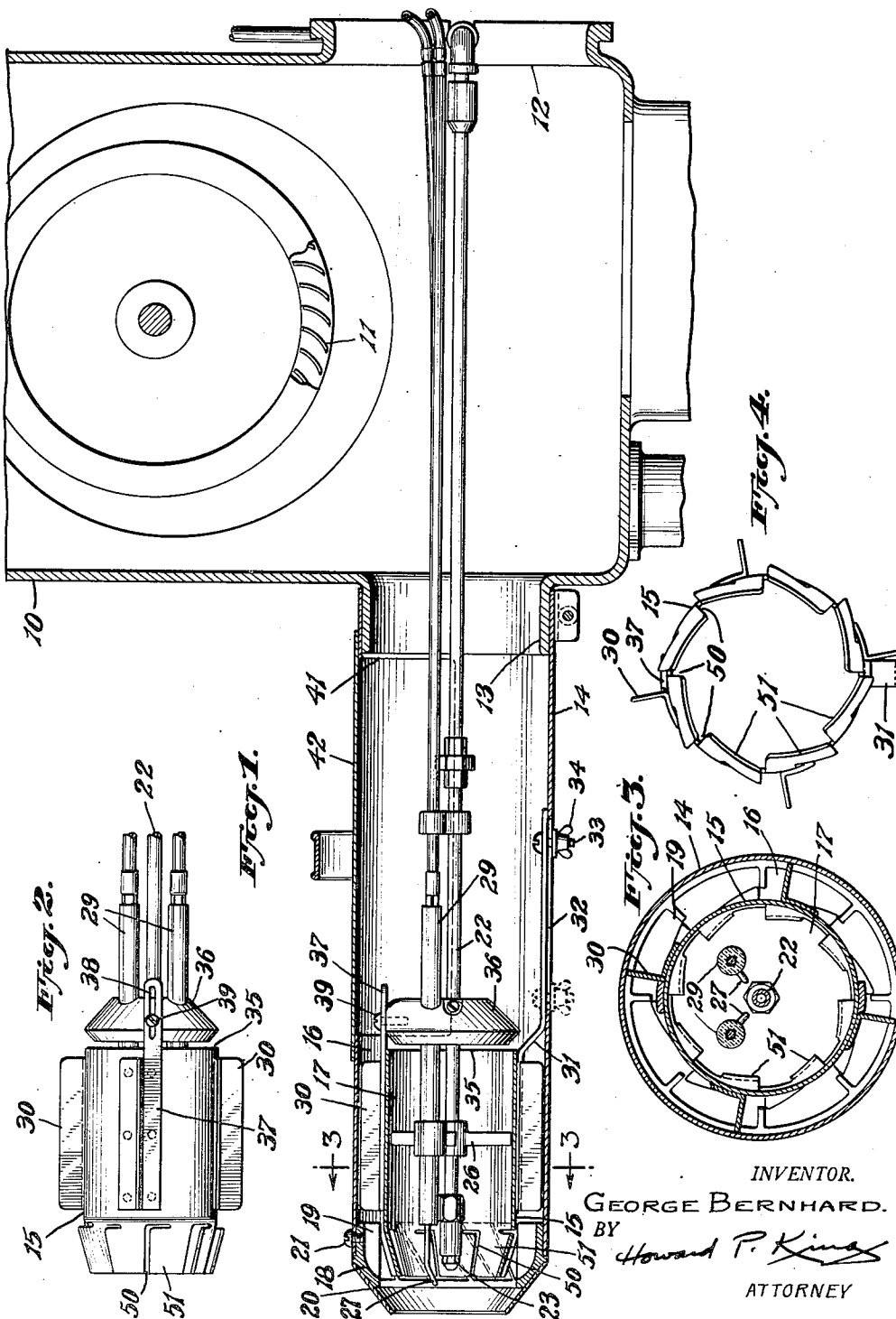


Filed Oct. 19, 1948

COMBUSTION APPARATUS

2 SHEETS--SHEET 1



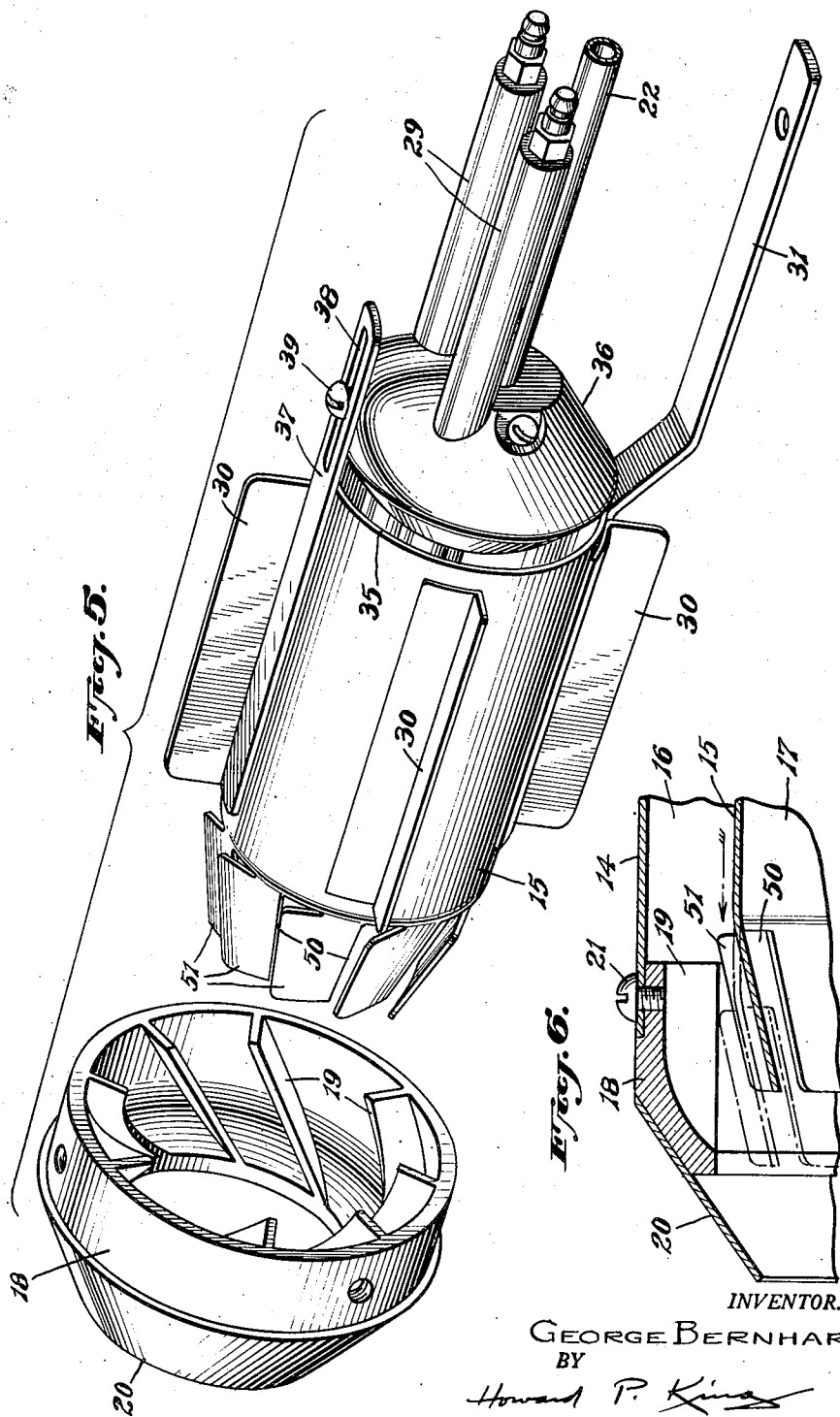
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G. BERNHARD
COMBUSTION APPARATUS

2,603,280

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2 SHEETS—SHEET 2



INVENTOR.
GEORGE BERNHARD.
BY
Howard P. King
ATTORNEY

UNITED STATES PATENT OFFICE

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COMBUSTION APPARATUS

George Bernhard, Hewlett, N. Y.

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5 Claims. (Cl. 158—76)

1

This invention relates to combustion apparatus, and particularly to devices utilizing liquid fuel and known in the trade as oil burners.

Due to lower costs and much faster recovery process, the major oil companies are interested in developing the catalytic method of cracking the crude oil, and thereby increasing the total quantity of gasoline produced. This means, however, that few of the lower and faster burning fractions will remain in the fuel oil after processing of the crude is completed, resulting in a heavier fuel oil the use of which places a greater burden and strain on the present-day oil burner the construction whereof is inadequate to handle the new hard-to-burn and heavier catalytic oil. In most cases present day oil burners cannot burn this catalytic oil.

Principal among the objects of the invention is the provision of a fuel oil burner capable of burning the heavier catalytic fuel oil effectively and efficiently.

Another object of the invention is to provide a structure which will both subdivide the oil into microscopic particles and surround those particles with air in spite of the viscous and heavy character of the oil used.

A further object of the invention is to provide means for effecting high-velocity properly controlled air supply and diffusion.

Again, an object of the invention is to provide for better stabilized control of primary air and improved turbulence creating means.

Yet another object of the invention is to reduce the over-all length of the air tube over prior art constructions.

A still further object of the invention is to provide for higher combustion chamber temperatures and a much steadier and more stabilized flame than in prior art constructions.

Other objects of the invention will appear to those skilled in the art to which it appertains as the description progresses, both by direct recitation thereof and by inference from the context.

Referring to the accompanying drawings in which like numerals of reference indicate similar parts throughout the several views:

Figure 1 is a vertical longitudinal section of a combustion apparatus in accordance with my invention;

Figure 2 is an elevation of the inner tube thereof with which is shown the adjustable air valve therefor and a part of the lead-in cables and fuel pipe;

Figure 3 is a cross-sectional view on line 3—3 of Fig. 1;

2

Figure 4 is a front end view of the inner tube; Figure 5 is a perspective expanded view of the inner tube and associated parts shown in Fig. 2, together with the whirl chamber and cone positioned forwardly therefrom; and

Figure 6 is a longitudinal sectional view of a portion of said inner tube, cone and whirl chamber in operative assembled relation.

In the specific embodiment of the invention illustrated in said drawings, the reference numeral 10 designates the main housing which provides for appropriate mounting and operation of a fan or blower 11 for creating the copious air supply required for apparatus of the character indicated. At the rear of this housing is an opening or hatch 12 for access to the interior, said hatch being normally closed with a cover (not shown) in operation of the burner. At the front of the housing, aligned with the rear opening or hatch 12 is a forward opening defined by a forwardly protruding hollow neck 13. Said neck constitutes a supporting means for a tubular jacket or blast tube 14 projecting forwardly from said neck and attached thereto. Coaxial to and within the blast tube 14 is an inner tube 15 considerably smaller and much shorter than the blast tube so as to provide an annular passage 16 between the inner tube and the forward part of the blast tube for the primary air flow from the housing to the forward ends of said tubes. The interior of inner tube 15 in like manner constitutes a passage 17 for the secondary air flow from the housing to the forward end of said inner tube. At the forward end of the blast tube 14 is a hollow nose or air concentrator 18 the interior whereof constitutes a whirl chamber by virtue of a plurality of spiral vanes 19 therein. For installations where needed, further air concentration may be obtained by addition of a frusto-conical hollow extension or choke ring 20 secured on the forward part of said nose as by screws 21. For convenience of reference, the nose and ring together are referred to herein as a cone.

Attention is directed to the fact that the general configuration of the forward end of inner tube 15 is a convergence in its approach to its inner end toward the furnace fire-box, whereby, in accordance with well-known Venturi theory, the secondary air velocity at the end of said tube is increased. The nose 18 likewise has a converging relation to the inner tube, thereby also increasing the primary air velocity from the nose. In those installations where the nose extension or choke ring is employed, the further constriction

introduced thereby additionally increases the velocity of the primary air which adds velocity impetus to the stream of secondary air enveloped thereby.

Coaxially within inner tube 15 is a fuel feed pipe 22 the forward end of which carries the usual or atomizing nozzle 23. The rear end of the coaxial feed pipe extends to the rear opening or hatch where connection is made to a fuel pump (not shown) or other source of fuel supply. Said fuel pipe 22 is supported and retained in its coaxial position by suitable means such as spider bracket 26 located in the inner tube and with the ends of the spider legs engaging the tube wall, and in slidable engagement for permitting longitudinal adjustment of the tube and pipe. The spider also makes provision for support and retention of spark-forming electrodes 27 extending longitudinally within the air tubes to a position next the fuel-ejecting forward end of the nozzle for igniting the fuel and instigating the flame. The electrodes are protected in their passage through the inner tube by enclosure within ceramic or other tubular insulators 29.

On the outside of inner tube 15 are secured a plurality of longitudinal fins 30 the outer edges of which have sliding contact with the inner surface of blast tube 14 thereby holding said tubes coaxial to each other but permitting the inner tube to be longitudinally adjusted with respect to the outer or blast tube. An adjusting bar 31 is secured to and projects longitudinally rearward from the inner tube and by being suitably offset is located in juxtaposition to a longitudinal slot 32 in the wall of the blast tube and is held in adjusted position therewith by screw 33 and wing nut 34.

The rear end of inner tube 15 constitutes an annular seat 35 for a forwardly facing valve head 36 coaxial therewith and slidable upon fuel pipe 22. This valve head is constructed, arranged and retained to enable a wide adjustment of secondary air flow to be obtained for the inner tube by retraction of the valve head varying distances from its seat to admit air up to full capacity of the tube if desired. As shown, the adjustment for said valve is by means of an arm 37 secured to and projecting rearwardly from the inner tube across an edge portion of said valve with a longitudinal slot 38 in the arm in vicinity of said valve to receive a clamping screw 39 therethrough threaded into the edge of the valve. A conveniently large hand-hole 41 is made in the outer tube in the vicinity of the valve head and its adjusting arm from access thereto as required. This hand-hole is closed, however, during operation of the combustion apparatus, by a suitable cover 42.

After careful research and extensive experimenting I have determined that in addition to the adjustment of oil and air supply which has been of rather haphazard nature in the prior art, that intermixture of the air with the atomized fuel relatively close to the nozzle is of primary importance. By controlling the actual spot at which the high speed stream of air reaches the fuel spray, the mixing of the oil and air is obtained most effectively. The catalytic fuel molecule gives up its carbon and hydrogen for combustion purposes with great reluctance, and only by surrounding the microscopic particle with air can the mixing to the extent necessary for smokeless and high-efficiency burning be achieved. High velocity and some degree of turbulence of the air has accomplished an advance toward the goal.

It has been found, however, that air velocity and varying turbulence still permit passage of a large proportion of fuel particles insufficiently surrounded by air. My investigations have determined that the cause of this deficiency lies in the fact that the Venturi action of the air passing the nozzle creates a vacuum in front of the nozzle for a considerable region, so that fuel in passing through that region is actually out of contact from air to surround the individual particles. That circumstance therefore affords opportunity for particles which collide with each other in that region to combine to form larger particles and when these larger particles enter the air stream their size precludes association of adequate air to obtain complete combustion. An essential object of the invention is accordingly provision of means to reduce and substantially eliminate the aforementioned vacuum and to immediately surround each microscopic particle with air as it leaves the nozzle or as the fuel becomes initially atomized.

In carrying out the inventive concept, the specific embodiment of means for the purpose is shown as accomplished by provision of a plurality of slits 50 longitudinally of the converging forward end of the inner tube in the part of said tube which girdles the nozzle. It is also preferable to form the metal next one corresponding side of each slit as a blade or scoop 51 the edge of which next the slit is outward radially. As these scoops and slits are within the hollow nose or concentrator 18 wherein the spiral blades establish a whirling turbulence, the scoop blades 51 are in the path of a portion of that whirling air and accordingly scoop it into the inner tube in a direction which spirals the air inwardly to the nozzle and to the region in front of the nozzle which otherwise would present the objectionable vacuum. The scoops and slits therefore not only admit the air to fill the void, but introduce the air to that region with a turbulence and transverse velocity to the direction of flow of the primary and secondary air to accomplish the desired surrounding of all of the fuel particles in their atomized state. This cross turbulence or air flow from the scoops furthermore will be effective to separate and break up globules of a plurality of particles into constituent particles and thus also aids in the atomizing of the fuel. Thus a far greater turbulence than was previously possible is created, atomization is enhanced, each minute particle is saturated with oxygen, the objectionable vacuum is reduced or eliminated and a more perfect and complete combustion is obtained and obtained closer to the nozzle than heretofore possible. It has been demonstrated by tests that 85% efficiency is attained by use of the present invention with a 440° stack temperature and 12% CO₂ flue gas reading. The installation tested shows a higher combustion chamber temperature and a much steadier and stabilized flame are obtained. Use of the invention definitely tends to eliminate any pulsation or flame fluctuations, setting adjustments are simpler and easier to make and the apparatus is more quickly serviced in the field than prior oil burners. The invention furthermore brings the flame closer to the nozzle, improves its form and color and reduces or eliminates "horsetailing," besides enabling the inner tube to be shorter and thereby also enabling the outer tube to be shorter for effecting an overall saving in length and a more compact apparatus. The burner of this invention not only successfully uses the heavier catalytic oils, one of

which was used in determination of the ratings given above, but also will operate with corresponding efficiency when burning lighter oils.

I claim:

1. Combustion apparatus comprising a blast tube, an inner tube coaxially within the blast tube, both of said tubes having forwardly converging constrictions at their forward ends, the forward portion of the converging constriction of the inner tube being substantially within the converging constriction of the outer tube, a nozzle and fuel supply therefor coaxial with said tubes and with the nozzle substantially within the converging constriction of the inner tube, and air-receiving and directing means provided at and as a part with the converging constricted portion of the inner tube for diverting air from the blast tube transversely of and within the converging constriction of the inner tube.

2. Combustion apparatus comprising a blast tube, an inner tube coaxially within the blast tube, both of said tubes having forwardly converging constrictions at their forward ends, the forward portion of the converging constriction of the inner tube being substantially within the converging constriction of the outer tube, said forwardly converging constriction of the inner tube having longitudinal slits therein with a margin of each slit having an outwardly projecting scoop for diverting a portion of the air from the blast tube transversely of and within the converging constriction of the inner tube.

3. Combustion apparatus comprising a blast tube, an inner tube coaxially within the blast tube, both of said tubes having forwardly converging constrictions at their forward ends, the forward portion of the converging constriction of the inner tube being substantially within the converging constriction of the outer tube, a nozzle and fuel supply therefor coaxial with said tubes and with the nozzle substantially within the converging constriction of the inner tube, said converging constriction of the inner tube having longitudinal slits therein, a margin next one edge of each of said slits extending outwardly into the passage between said tubes thereby constituting a scoop for diverting a portion of the air from the blast tube transversely of and within the converging constriction of the inner tube.

4. Combustion apparatus comprising a fuel

nozzle and a first air tube around the same with a constriction for passing air to a region in front of said nozzle, a second and larger air tube coaxial with and around the first said tube, both said tubes having an air supply provided at a rear part of said tubes and both of said tubes being open at their forward ends for copious discharge of air forwardly therefrom, and air-diverting blades on the first said tube and around the nozzle traversing a plane substantially diametrically across the end of said nozzle and said blades being angularly disposed to the direction of air flow in the larger tube and directing a part of the air from the larger tube into said region in front of the nozzle.

5. Combustion apparatus comprising a fuel nozzle, a blast tube radially outside of and coaxial with said nozzle, said blast tube having air turbulating vanes therein and having a forward open end for discharge of a column of air therefrom in front of the nozzle, and an inner tube within said outer tube and between said turbulating vanes and nozzle, said inner tube having blades directed toward said turbulating vanes for scooping a portion of the turbulated air and having slits at the basal ends of said blades for passing the scooped air to the region directly in front of said nozzle and within the column of air discharged from said forward open end.

GEORGE BERNHARD.

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