Nov. 15, 1949 J. S. ZINK 2,487,959

DIRECTIONAL HEAT FLUID FUEL BURNER

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Fig. 1

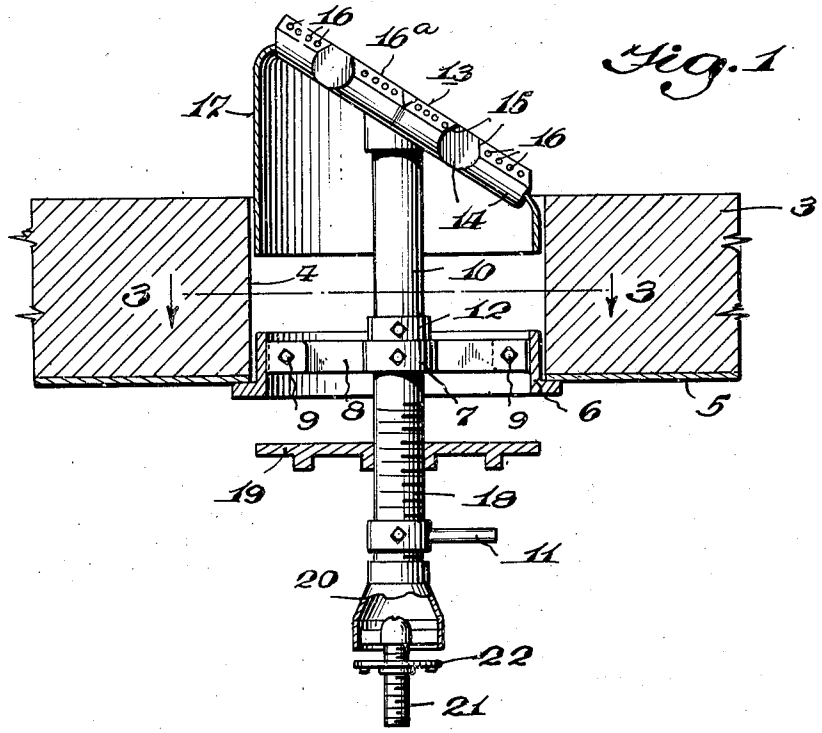


Fig. 3

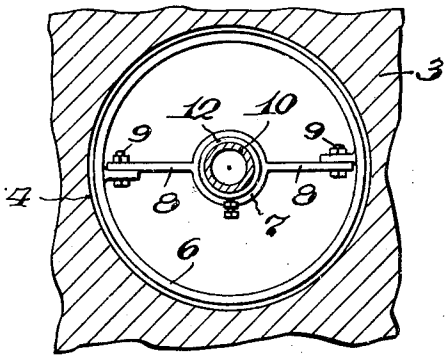


Fig. 4

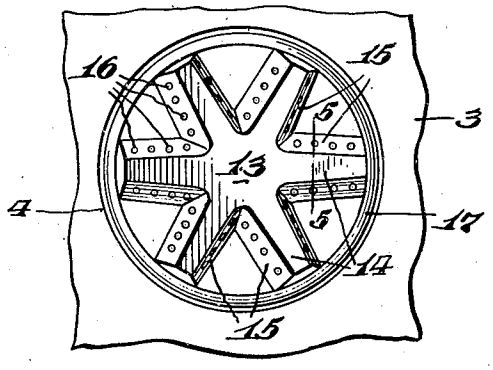
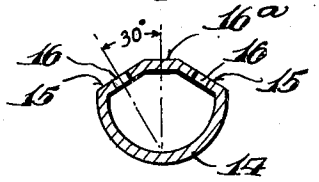


Fig. 5



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Fig. 2

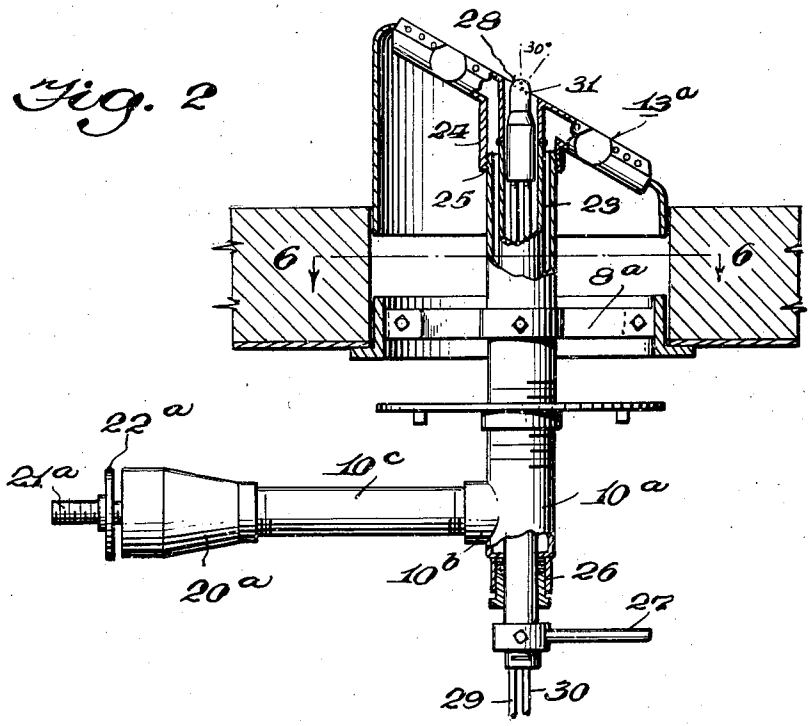


Fig. 6

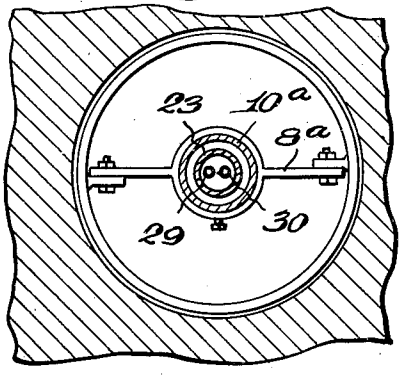
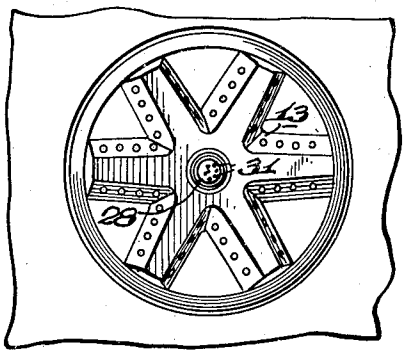


Fig. 7



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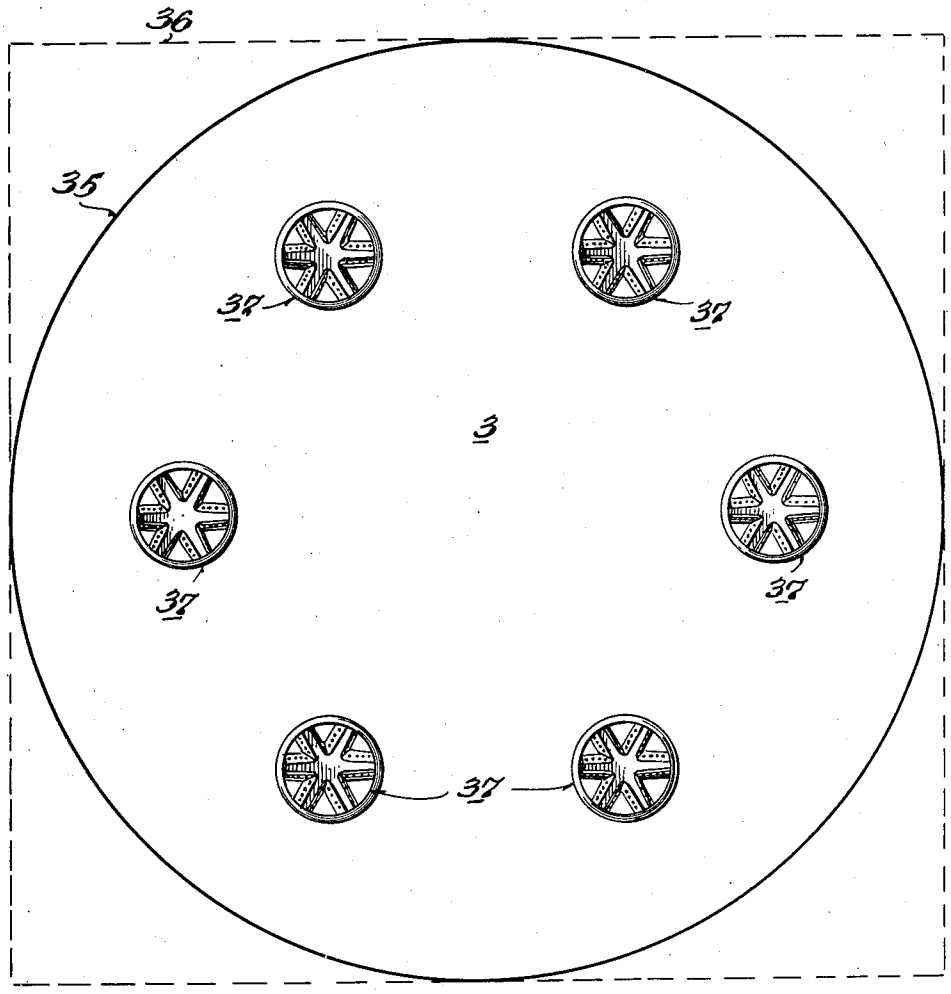
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Fig. 8



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DIRECTIONAL HEAT FLUID FUEL BURNER

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3 Claims. (Cl. 158—11)

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This invention relates to a means of controlling the transfer of heat in a circular or substantially rectangular heater.

In accordance with the invention the heat is discharged from a plurality of sources arranged in a circle in either the floor or the roof of a heater; the sources of heat being so positioned as to discharge heat at angles to the longitudinal axes of the burners in such a manner that the direction of discharge may be varied through three hundred and sixty degrees at the discretion of the operator.

Heretofore it has been proposed to use a forced draft for this purpose and to employ a unitary burner, whereas I intend to use a number of separate units or burners with a natural draft. With burners arranged as I propose, it is possible to cause heat to be either concentrated at an optimum point or equally dispersed throughout the combustion zone simply by altering the direction of discharge of the burners. It is also possible by the use of my invention to increase the efficiency of a heater by creating a rotary or radial motion in the mass of flue gas flowing through the combustion zone, thus causing a much richer flow of the gases over the heat transfer surfaces and a correspondingly greater transfer of heat by convection in the combustion zone. This increased transfer permits greater efficiency because regardless of the excess air being used in the heater, the stack temperature is lower. Since the excess air stack temperature relationship determines the efficiency of operation, any decrement in either will result in a greater efficiency.

By the use of my invention the heater cost is reduced because it is not necessary to provide a refractory lined recess in the floor of the ceiling of the heater to provide an atmosphere or rich radiant heat or a Dutch-oven effect to obtain complete combustion as is the case with prior proposals. This feature is advantageous in that the flue gases are not concentrated in my design as they would be in the prior art since they issue from a relatively small circular space or recess. Thus, the travel of the hot gas is assisted on its way to the transfer surface.

These desired results are achieved mainly by using the novel directional heat burners which I have designed.

In accordance with the present invention the secondary air supplied to the burner is directed only parallel to the axis of the burner feed pipe or pipes and the burner barrel extends into the furnace only slightly. The direction of the heat is in the direction of the face of the spider or

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burner-head which is disposed at an obtuse angle to said axis; the direction of the face of the spider being adjustable so that the direction of the heat is brought about by the energy of the gas. In other words, I do not use the energy of the air or change the direction of the air by a nozzle as was done heretofore. I change the direction of the fire simply by changing the direction in which the spider or burner-head faces and in that way employ the kinetic energy of the high pressure gas. Due to my improved construction the burner may be installed in a wall of the chamber to be fired, horizontally or vertically upward or downward, and it is especially efficient for use with high pressure gas; that is gas about 1# gauge pressure.

It will, therefore, be understood that one of the primary objects of my invention is to provide a directional heat burner in which the directing is brought about by the adjustment of the spider or burner-head so that it faces in any desired direction away from the axis about which the burner-head is rotatable.

With the foregoing objects outlined and with other objects in view which will appear as the description proceeds, the invention consists in the novel feature hereinafter described in detail, illustrated in the accompanying drawings, and more particularly pointed out in the appended claims.

In the drawings Fig. 1 is a side elevation partially in longitudinal section, of a gas burner forming part of the invention, shown in connection with an opening in the floor of a furnace or the like.

Fig. 2 is a similar view showing the invention embodied in a combination oil and gas burner.

Fig. 3 is a horizontal sectional view taken on the line 3—3 of Fig. 1.

Fig. 4 is an end view of the gas burner looking toward the face of the spider.

Fig. 5 is a sectional view of one of the arms of the spider taken on line 5—5 of Fig. 4.

Fig. 6 is a horizontal sectional view of the combination burner taken on the line 6—6 of Fig. 2.

Fig. 7 is a view like Fig. 4, but illustrating the burner shown in Fig. 2.

Fig. 8 is a diagrammatic plan view of a heater provided with a series of my improved burners.

In the embodiment of the invention illustrated in Figs. 1, 3, 4, and 5, 3 designates the floor of a furnace or the like, provided with a vertically disposed port 4. For the purposes of the present invention, a steel plate 5 may be arranged at the bottom of the floor and have a hole register-

ing with the port 4 to receive a thimble 6 secured to the floor by any preferred means. A yoke 7 is positioned centrally of the port and is provided with diametrically oppositely extending arms 8, that are rigidly secured to the thimble by bolts 9 or the like.

A rotatable tube 10 is vertically arranged centrally of the port and passes loosely through the yoke 7. Such tube may be rotated by any suitable means such as a handle 11, fixed thereto below the floor, and the tube is provided with an axially adjustable collar 12 which rests on the yoke for supporting the tube at various heights.

A burner-head or spider 13 is fixedly mounted on the upper end of the tube and may be of the general type disclosed in my Patent 1,781,623, dated Nov. 11, 1930. That is, it may have a number of hollow arms 14 which radiate from the tube and receive gas from the latter, and each arm may be provided with converging walls 15 having gas discharge ports 16 to discharge gas at an angle of about 30 degrees relatively to the axis of the tube. The spider in accordance with the present invention is positioned at an acute angle (about 30 degrees) to the tube whereby it will direct the gas in various directions depending on the position of the tube, brought about by adjustment of the latter. As the tube can turn 360 degrees it is obvious that the heat can be directed in any direction away from the axis of the tube.

A tubular air shield 17 has a truncated discharge end secured to the ends of the arms of the spider and such shield projects downwardly into the port 4 in order to guide the secondary air relatively to the spider. At this point it will be noted that the air travels normally parallel to the tube, but due to the discharge of gas under pressure from the spider and the coincidence of the truncation of the shield and the plane of the spider, some air will be entrained by the gas and will be directed by the latter, depending, of course, on the position of the spider with reference to its axis of rotation. The shield will cause all air flowing through the burner register to pass through the spaces between the arms of the spider and thus prevent the escape of necessary air from the combustion zone directly forwardly of the spider.

Obviously the longitudinal axis of the air shield is coaxial with the tube to permit unobstructed rotation of the tube, spider and air shield, which rotate as a unit.

Below the yoke 7 the tube is provided with external threads 18 having threaded engagement with a secondary air door 19 which obviously may be adjusted toward or away from the thimble 6 to control the volume of secondary air passed to the burner. Like in my above-mentioned patent, the lower end of the gas tube is provided with a mixer 20 in which the primary air is mixed with gas entering through a supply pipe 21. A primary air door 22 is in threaded connection with said pipe for use in regulating the primary air introduced into the mixer.

From the foregoing it is believed that the operation of the burner is obvious, as the gas entering through the supply pipe 21 under pressure will induce the flow of primary air into the mixer 20 from which the combustible mixture will travel through the tube 10 and be discharged through the holes 16 of the spider which will direct jets of the mixture at angles to the face 16*a* of the spider. The tube may be turned at any time to change the direction of the flow and, of course, the jets discharged from the spider will induce the flow of secondary air which will complete the combustion within the fire box.

Since the flow of fuel is at an angle of about 30 degrees to the longitudinal axis of the burner tube and since the assembly of spider, air shield, and central tube may be rotated about the longitudinal axis of the burner through an arc of 360 degrees or any portion thereof, the direction of heat flowing away from the burner may be controlled at the discretion of the operator.

Obviously a directional burner of this character permits the election of the direction in which the heat is to flow away from the burner so as to set up optimum heat concentration conditions in any type of furnace. It also allows for optimum conditions of heat dispersed in the furnace and thereby eliminates zones in which the temperature is higher than in others. Consequently, the operator is able to obtain precise control of his furnace to the satisfaction of any process condition. Furthermore, it permits the establishment of optimum conditions of heat transfer in a process heater without making it necessary to decrease the feed of fuel into the heater. This feature is particularly important in that any decrease in fuel flow would result in a smaller volume of material processed. It offers another means of control for critical heat transfer devices used in processing various materials.

The combination oil and gas burner disclosed in Figs. 2, 6, and 7 is quite similar to the one above described, so far as the gas is concerned, but is modified as follows: The tube 10*a* instead of being rotatable and receiving the mixture through its lower end, is fixed to the yoke 8*a* and provided with a lateral nipple 10*b* that is connected to a horizontal pipe 10*c* which in turn is connected to the mixer 20*a*, receiving the gas from a supply pipe 21*a*. Here also the introduction of the primary air is controlled by a door 22*a*. A rotatable guide tube 23 extends through the gas tube and merges at its upper end with the spider 13*a*. The spider in this instance is provided with a skirt 24 having a threaded connection with the upper end of the tube 10*a*, as indicated at 25, and the pitch of the threads at this joint is so slight that the spider may readily turn on the tube 10*a*. For this purpose the guide tube 23 extends at this lower end portion through a packing gland 26 and is provided with a handle 27, the manipulation of which causes the turning of the guide tube and the spider.

An oil gun having a dome shaped tip 28 projecting through the spider, is supplied with oil through a pipe 29 and with steam through a pipe 30. In accordance with the invention a circular series of holes 31 are drilled in the oil tip about an axis positioned at an angle (preferably 30 degree) relatively to the axis of the guide tube 23, so that the oil jets will be directed in the same general direction as the gas discharged from the spider 13*a*, regardless of the position of the spider about its axis of rotation.

In both types of burners it will be noted that the secondary air port and the air shield form a barrel and the face of the spider is inclined at an angle of substantially 30 degrees to the axis of such barrel. Furthermore, the spider in each instance is supplied with a gas-air mixture. The ports through which this mixture flows are so drilled and arranged as to project the heat pattern at an angle of approximately 30 degrees to the axis of the burner barrel regardless of the

direction in which the spider is facing. The air-gas mixture in my burners is not discharged from the central portion of the burner barrel to flow across the air stream moving into the furnace through the barrel. On the contrary, the radiating arms of the spider distributes the gas-air mixture across the secondary air stream.

The directional effect is obtained through dissipation of the kinetic energy of the gas-air jets as they discharge from the spider. No effort to influence the variable direction of the secondary air is made by any means. The barrel is entirely straight throughout its entire length. The approximately 30 degree angle of discharge causes the gas-air streams to cut across the secondary air stream thus providing air for combustion while the secondary air stream is allowed to go in a substantially vertical direction. Obviously it is not necessary in apparatus of this kind to rotate the entire assembly to obtain the directional effect, since it may be obtained through altering the direction in which the spider faces.

It will also be understood that it is unnecessary for the burner barrel to project into the furnace since it has no part in obtaining the directional effect. It is simply a device intended to deliver secondary air to the point at which the gas-air mixture is discharged without in any way altering the direction of air flowing to the combustion zone. Other means of delivering secondary air to the combustion zone without requiring coincidental rotation of the register and spider may be used with equal satisfaction.

The truncation on the discharge end of the barrel is for purely mechanical reasons which involve attachment of the spider to the barrel, but since this barrel is not in any way absolutely necessary as a projection into the furnace, in some instances it may be eliminated. It provides a means of preventing influx of flue gas into the air stream.

Either one of my improved burners may be used in multiple in controlling the heat in a furnace or the like. For example, in Fig. 8, I have shown a fire chamber which may be circular in shape as indicated at **35** in full lines or substantially rectangular as indicated at **36** in dotted lines. In either embodiment the burners **37** may be arranged in a circular series at the roof or floor of the furnace, and as they will be placed in radial lines, radiating from the center of the fire chamber, it is obvious that the heat may be concentrated wherever desired. By arranging the burners so that the heat flow is tangentially directed in the same direction from radii of the furnace, a circular moving stream of hot gases is created. Such circular movement causes the gases to flow or to sweep all around the heat transfer surfaces at a relatively high velocity, thus increasing the amount of heat transferred per square foot of transfer surface through the increment of convection due to the flow of hot gases.

The directional effect as obtained in a substantially circular furnace is an improvement over existing designs because:

1. The construction is greatly simplified and the cost of the heater is reduced as it is not necessary to construct a refractory lined recess, a pilaster in the center of the furnace or other mechanical or constructional means to obtain suitable combustion and heat transfer conditions.

2. With the burners arranged in a circular series in either the floor or the roof of the furnace and discharging their heat in a direction tangential to radii of the circle and also in a direction at an angle to the longitudinal axes of the burners, it is possible to create a body of hot gases which move both radially and axially so that a condition of turbulence is set up to assure even distribution of heat throughout the mass of the hot gases. The circular movement of the gases causes them to sweep over and around the heat transfer surfaces much in the manner of hot gases in the passes of a boiler, to increase the amount of heat which may be caused to flow through the transfer surface due to the convection effect obtained in the flow of the hot gases over the surface. This permits operation of the heater in a more economical manner since the stack temperature would be lower due to the extraction of the heat, caused by the convection effect so obtained. If the circular motion of the hot gases did not exist the amount of heat extracted by convection would be lost up the stack.

3. With the burner so arranged, the tangential movement of the gases causes the same amount of heat to be transferred at all axially progressive points on the heat transfer surfaces at the periphery of the heater. Because of the sweep of hot gases the amount of heat transferred around the periphery of each tubular heat transfer unit will be more nearly equal than would be the case if transfer should be by radiation alone.

4. With the burners so disposed in either the floor or the roof of the heater and so arranged as to permit altering the tangential discharge direction through an arc of 360 degrees by each burner, it is possible to concentrate the heat in any part or parts of the furnace to satisfy the heat concentration or demands of any process. This is particularly desirable where two processes are being carried out in the same furnace, as in two-or-more-pass operations such as in the treatment of hydrocarbon fluids.

5. By altering the point of greater heat concentration it is possible to control the process without necessarily decreasing or increasing the flow of fuel.

From the foregoing it is believed that the construction and advantages of my improved system and the units thereof may be readily understood by those skilled in the art, and I am aware that changes may be made in the details disclosed without departing from the spirit of the invention as expressed in the following claims.

What I claim and desire to secure by Letters Patent is:

1. A burner of the character described comprising a means having a port for the entrance of air, co-axial inner and outer tubes extending axially through the port, means fixedly supporting the outer tube, the inner tube being rotatable in the outer tube, a spider fixed to the inner tube and arranged at an angle thereto between 20 and 40 degrees, said spider having hollow arms radiating from said axis and communicating with the space between the inner and outer tubes, gas discharge ports provided in said arms, and a tubular air shield fixedly connected to the ends of the arms and projecting into the first-mentioned port.

2. A burner of the character described comprising a means having a port for the entrance of air, co-axial inner and outer tubes extending axially through the port, means fixedly supporting the outer tube, the inner tube being rotatable in the outer tube, a spider fixed to the inner tube and arranged at an angle thereto be-

tween 20 and 40 degrees, said spider having hollow arms radiating from said axis and communicating with the space between the inner and outer tubes, gas discharge ports provided in said arms, an oil gun mounted within the inner tube and having a tip projecting beyond the face of said spider, said tip having ports therein arranged at angles to the axis of the tip for directing jets of oil in the same general direction as the gas discharged from the spider, and means for feeding oil and steam to said gun.

3. A burner of the character described comprising a means having a port for the entrance of air, co-axial inner and outer tubes extending axially through the port, means fixedly supporting the outer tube, the inner tube being rotatable in the outer tube, a spider fixed to the inner tube and arranged at an angle thereto between 20 and 40 degrees, said spider having hollow arms radiating from said axis and communicating with the space between the inner and outer tubes, gas discharge ports provided in said arms, and means for introducing a mixture of air and gas into the space between said tubes anterior to said spider.

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