May 23, 1972 N. E. FLOURNOY ET AL 3,664,804

OIL BURNER

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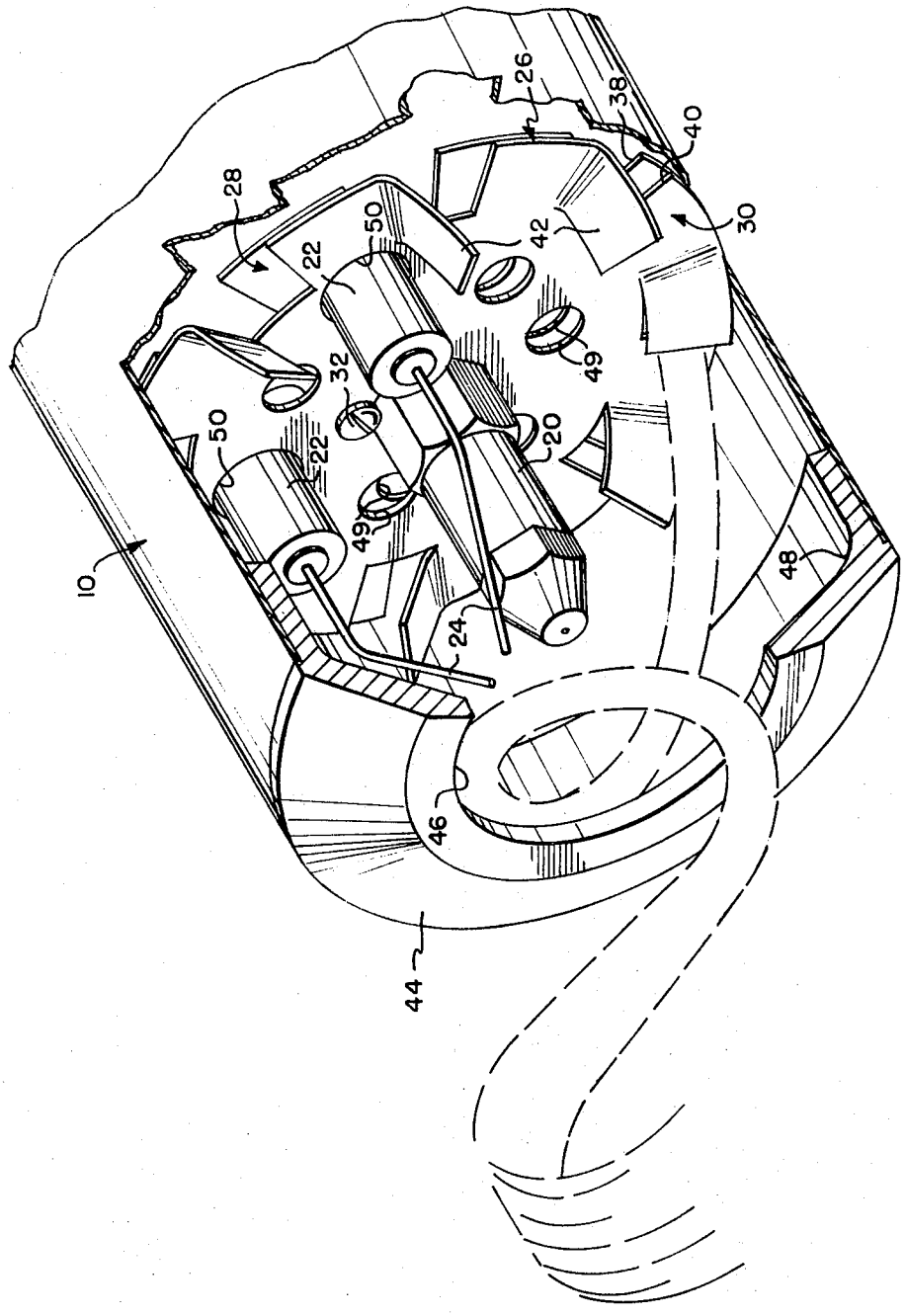
FIG. 1

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OIL BURNER

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FIG. 3

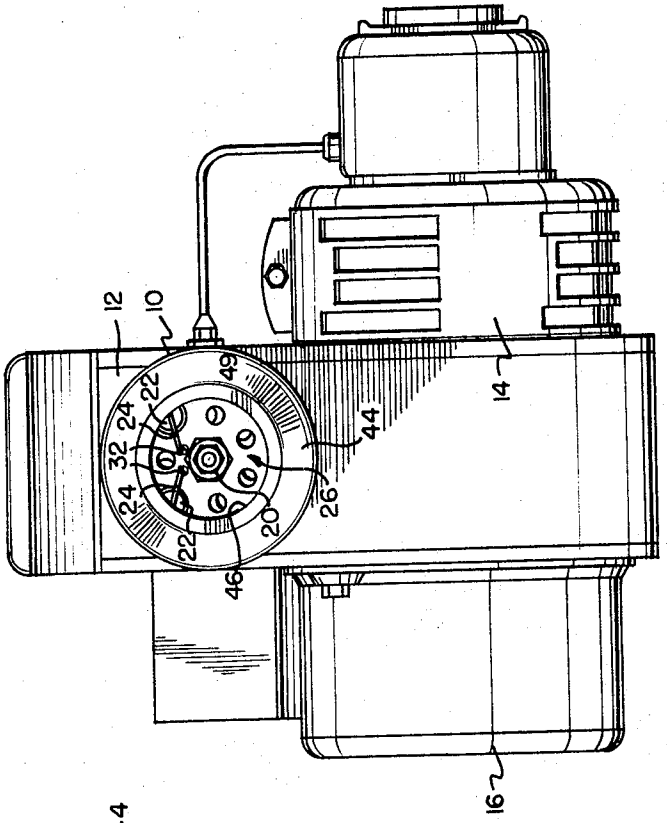
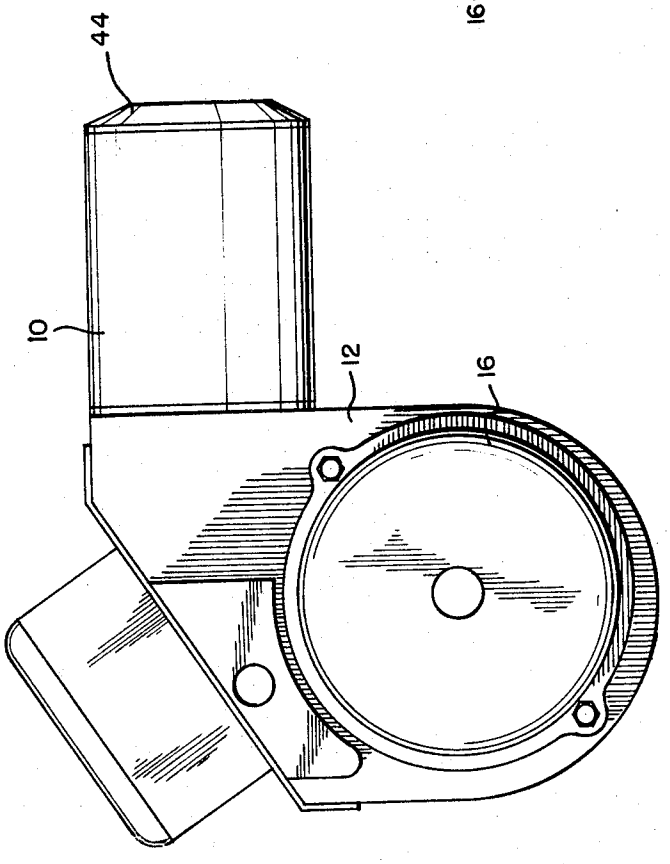



FIG. 2

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OIL BURNER

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FIG. 5

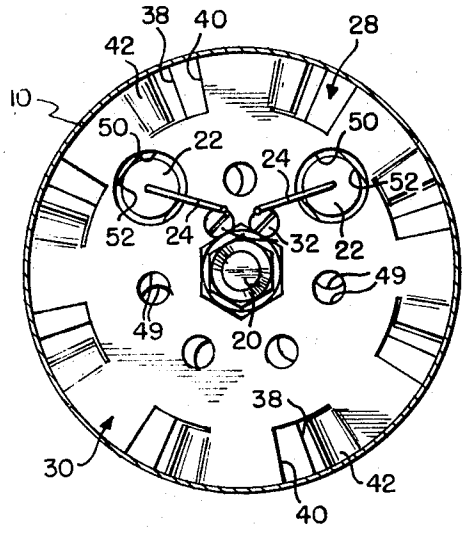



FIG. 4

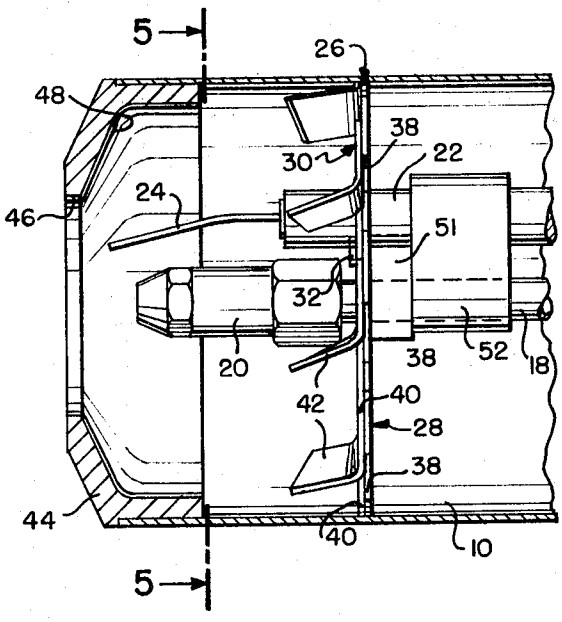



FIG. 6

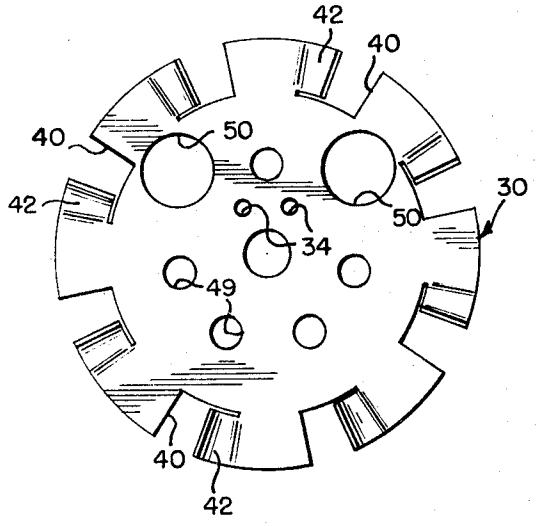
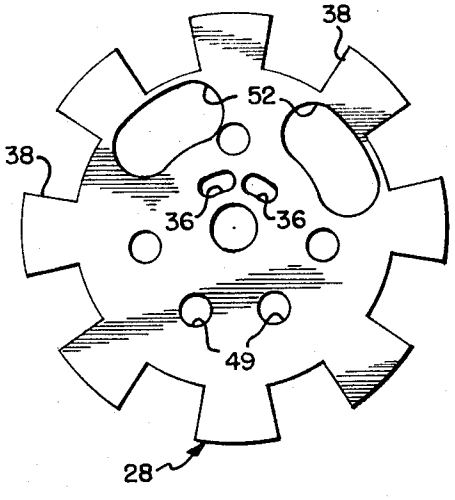



FIG. 7




71,835 (3-3)

United States Patent Office 3,664,804 Patented May 23, 1972



3,664,804

# OIL BURNER

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Int. Cl. F23m 9/08
U.S. Cl. 431—183 4 Claims

## ABSTRACT OF THE DISCLOSURE

A gun type oil burner having a restriction plate in the barrel with adjustable orifices provided with struck-out radially extending deflecting vanes to effect a spiral spinning action of the air stream upstream of the burner tip, said burner tip involving a frustoconical collar to constrict and choke the spirally flowing air.

The present invention relates to an oil burner and more particularly to a burner of the so-called gun type wherein a spray nozzle for liquid fuel, disposed within the end of a gun barrel or blast tube, projects a conically expanding pattern of finely atomized fuel particles into a highly turbulent flow of air emanating from the blast tube.

More specifically, the invention concerns a structural arrangement for improving the efficiency of combustion. In general, combustion is facilitated by producing an ideal intermixture of finely divided liquid fuel particles in a stream of air. This not only demands a fine subdivision of the oil particles but a high degree of air turbulence or intermixing, such that the particles are immediately distributed both uniformly and fully thruout the air stream.

The present invention achieves this effect in large measure by providing a cylindrical blast tube in which air under pressure is caused to blow axially therethru in a series of annularly spaced, separately metered jets located just inside the surface of the blast tube or gun barrel.

In accordance with the present invention, these streams or columns of jets are formed by passing the air under pressure thru adjustable orifices, each provided with a deflector or vane which makes an angle between axial and tangential directions. Moreover, each of the orifices is so baffled that each stream or jet therefrom is inclined in the same tangential or annular direction in the tube. As a result, the potential energy of the compressed gas upstream of the orifices is transferred into kinetic energy of high speed rotation about the fuel nozzle and is, in turn, passed thru a frustoconical choke or tip at the end of the blast tube, which yet further enhances the rotational velocity of the spinning air mass.

It will be apparent therefore that the present invention results in the incidence of a considerable rotational velocity of the air stream in the immediate vicinity of the oil spray nozzle so that the atomized particles are picked up and instantaneously distributed thruout the gas, particularly as it expands from the choke or end cone of the burner.

This invention, as will be apparent from the foregoing, is related to that described and claimed in U.S. application S.N. 78,069, filed Oct. 5, 1970, wherein a relatively high pressure flow of air passes thru an orifice to form a series of axially directed, annularly arranged high speed jets or columns of air. These, in turn, impinge directly into respective, spirally arranged channels on the inner frustoconical surface of a conically shaped end cone or orifice. In other words, each high speed column or jet of air is individually passed into a radially inwardly extending spiral channel formed on the inner surface of the burner choke and thus raised to a high rotational speed



before it is released thru the aperture at the end of the burner.

Referring now to the figures of the drawing wherein one illustrative embodiment of the invention is shown in detail, FIG. 1 is a perspective detailed view of the extremity of the burner tip with portions broken away to disclose internal detail; FIG. 2 is a side elevation of the burner; FIG. 3 is a front elevation of the burner; FIG. 4 is a transverse section thru the tip of the burner of FIG. 1; FIG. 5 is a sectional elevation taken on the line 5—5 of FIG. 4, and FIGS. 6 and 7 are plan views respectively of the fixed and relatively movable orifice plates.

In the embodiment shown, a blast tube or gun barrel **10** protrudes from the more or less conventional plenum housing **12**, supplied by air under pressure from a squirrel cage centrifugal blower within blower housing **12** and driven by a motor **16**. Since blower motor, ignition control, pumps, etc., are all familiar to those skilled in the art they are not to be described in detail.

Liquid fuel is supplied to nozzle **20** thru a central conduit **18** (see FIG. 4) coaxially disposed within the burner tube. The tube, as shown, also carries insulators **22** and electrodes **24** for initiating combustion.

The entire internal assemblage of structures, including the nozzle and electrodes is, in turn, located and supported in the blast tube by means including an air plate assembly **26**.

The air plate assembly, which forms an important part of the present invention, comprises an inner air plate **28** and an outer air plate **30**, both normally held flatwise with respect to one another by machine screws **32** which pass thru holes **34** in plate **30** and pass thru apertures **36** in plate **28**. The machine screws **32** also hold the plate assembly **26** against spacer block **51** which is mounted on an electrode holder **52**.

The plates embrace the central axial fuel supply conduit **18** and are rotatable about the center thereof. The respective plates **28** and **30** each have a circular peripheral edge of the same diameter as the internal diameter of the cylindrical blast tube so that they support the rest of the assembly therein. Also, the periphery of the plates are provided with essentially matching peripheral recesses **38** and **40** respectively, the effective size or opening of which can be controlled and predetermined by simply loosening machine screws **32** sufficiently to permit rotation of the two plates with respect to one another. In one rotational position where the matching recesses are in alignment, the opening is maximum. All other positions result in greater restriction. Therefore, when the appropriate size opening has been selected, tightening of the machine screws **32** prevents further change.

An important feature of the present invention comprises a series of baffles or directional vanes **42**, formed adjacent a corresponding radial margin of each of the recesses **40** on the outer plate **30**, namely the plate closest to the burner tip.

As clearly shown in the figures of the drawing, these baffle members or directing vanes are preferably stamped out of the plate itself, being the material which otherwise occupied the space formed by the respective recesses **40**, and remaining integrally affixed along one radial edge of the recess.

It is furthermore important to note that each of these projects from a corresponding radial edge of the recess, as for example, the left hand margin of the recess as viewed in FIG. 5. They, therefore, extend in essentially the same rotational direction, as well as downstream or toward the burner tip.

Stated in another way, each of the directing vanes makes an acute angle with the axis of the blast tube in the same rotational direction within the tube.

They are also arranged in annular, regularly spaced relationship and in close proximity to the interior cylindrical wall of the blast tube.

As a result, therefore, the sum of the multiple jets of air issuing from the air plate assembly reaches the extremity of the burner as a unitary rotational stream, spinning at a high rate about the axis of the blast tube.

At this point it hits the inner surface of a frustoconical choke or restricted collar **44** which extends radially inwardly as well as axially downstream from the end of the burner as shown in FIGS. 1 and 4. Thus the collar or choke **44** forms a restricted orifice **46** for the stream of gas which necessarily impinges and flows downstream along the inner conical surface of the choke as at **48**. The net result therefore is that the rapidly spinning spiral stream of gas is suddenly restricted at the burner tip to a substantially decreased path of rotation so that the rate or speed of rotation is at the same time sharply increased in known ways.

Conversely, the gas leaving the restricted orifice **46** immediately expands, carrying within it the atomized spray from the nozzle **20** thus effecting improved combustion.

It is also to be noted that in order to prevent stagnation and undesired eddies within the central section of the blast tube downstream from the air plates, it is necessary and desirable to provide additional relatively small apertures **49** in the plates. These are annularly arranged in matching patterns on the two plates as shown in FIGS. 6 and 7 so that in assembled form they likewise are in correspondence to the adjustment of the larger peripheral apertures **38** and **40**, as previously mentioned. Also, it is to be noted that plate **30** is provided with mating apertures **50** to receive insulators **22**, the plate **28** being provided with matching slots **52** to permit the necessary relative rotation of the two plates.

In effect, therefore, the outer plate, with its deflectors **42**, is arranged to direct jets of air axially downstream at a slight angle in an annular direction so that all of the jets are spiralled in essentially the same rotational direction. Moreover, as the spiralling air stream reaches the inner frustoconical surface of the choke ring its rate of flow correspondingly increases so that it leaves the frustoconical end of the burner tip as a whirling jet in a high state of turbulence. This, therefore, results in instantaneous, uniform admixture of the spray of finely particulate liquid fuel which affords excellent flame shape and uniform temperature distribution and greatly improves combustion efficiency.

By way of example, a standard commercial gun-type burner, namely the Texaco Model 135–A7 burner with a 0.9 gal./hr. 80° solid cone nozzle was subjected to a series of tests to determine the smoke number at various values of excess air. The same burner was then modified in accordance with the present invention by instalilng the air plate assembly as shown herein and changing from a vaned end cone to the hereindescribed vaneless end cone. Also it is to be noted that the speed of rotation of the burner fan was doubled in order to raise the pressure of the air sufficiently to counteract the throttling and restrictive effect of the air plate assembly and maintain sufficient upstream pressure of air to create jets of air thru the plate assembly orifices as well as to maintain the excess air ratios hereinafter described. More specifically, the latter effect was achieved by driving the squirrel cage blower fan of the burner at a speed of 3450 r.p.m. as against the prior 1725 r.p.m. rotational speed. It is to be noted that aside from these changes, the burner was completely unaltered and in the same condition as in the tests reported for the unaltered burner.

Following is data realized from the results of these tests in which A represents the results realized with the standard gun-type burner unmodified or unaltered in any respect and B represents the comparative results of the identical



burner modified in the two respects mentioned above, to conform with the present invention.

| | Excess air, percentage | Smoke number |
|---|---|---|
| A | 51 | 0 |
| B | 19 | 0 |
| A | 25 | 4.5 |

As mentioned in the aforesaid copending application S.N. 78,069, the maintenance of a substantially increased pressure upstream of the air plate inherently overcomes heavy pulsations which are common in conventional commercial burners, due presumably to the fact that pressure fluctuations in the firing chamber are not transferred thru the area of relatively high pressure beyond the plate assembly.

We claim:

**1.** In a gun type oil burner having a cylindrical gun barrel or blast tube supplied with air under substantial pressure, a fuel nozzle coaxially arranged in the blast tube in the vicinity of its downstream extremity and supplied with a liquid fuel to form a predetermined pattern of highly atomized fuel particles, and means for igniting said fuel, the improvement which comprises

a circular air plate assembly transversely occupying the interior of the blast tube adjacent but upstream of said nozzle,

said air plate assembly comprising separate circular plates having a diameter substantially equal to that of the interior of said blast tube and arranged flatwise for rotational adjustment with respect to one another about the axis of said burner,

said plates having corresponding apertures annularly disposed adjacent the periphery thereof and arranged so that said rotational adjustment of said plates will predetermine the effective opening of said apertures to the flow of air,

said downstream plate having struck-out, deflecting vanes extending axially and tangentially from the corresponding radial margin of each aperture and in a down direction to effect a substantial spiral spinning action of the streams of air issuing from the respective orifices,

the downstream end of said gun barrel carrying a frustoconical collar coaxially thereon and extending radially inwardly and in a downstream direction to provide a restricted central aperture at the inner extremity of said frustoconical member to choke said spirally flowing air during passage thru said burner tip,

said aforementioned blast of air being effective to provide a pressure upstream of said adjustable air plate assembly to provide substantial jets of air thru the said orifices.

**2.** A gun type oil burner as called for in claim **1** wherein said circular air plate assembly comprises coaxially arranged plates in which said annular spaced peripheral orifices adapted to register congruently in one angular position thereof and in all other angular positions enable predetermined restriction of the effective opening of said orifice.

**3.** A gun type burner as defined in claim **1** wherein said annularly spaced peripheral orifices comprise radial inwardly extending struck-out recesses, the struck-out portion being folded the corresponding radial margin of each recess and extending in an axial and tangential direction such that the jets of gas issuing from said apertures are caused to spin within the blast tube in the same annular direction.

**4.** A gun type oil burner as defined in claim **3** wherein said regular air plate assembly is provided with small adjustable orifice means in the central portion thereof, adapted to provide a limited flow of air in the central part

of the blast tube about the fuel nozzle, thereby to avoid eddy current flow of air.


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EDWARD G. FAVORS, Primary Examiner

U.S. Cl. X.R.

239—405, 407; 431—265