Jan. 10, 1933. H. MEACHEM 1,893,902

METHOD OF LIQUID FUEL COMBUSTION

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Fig. 1

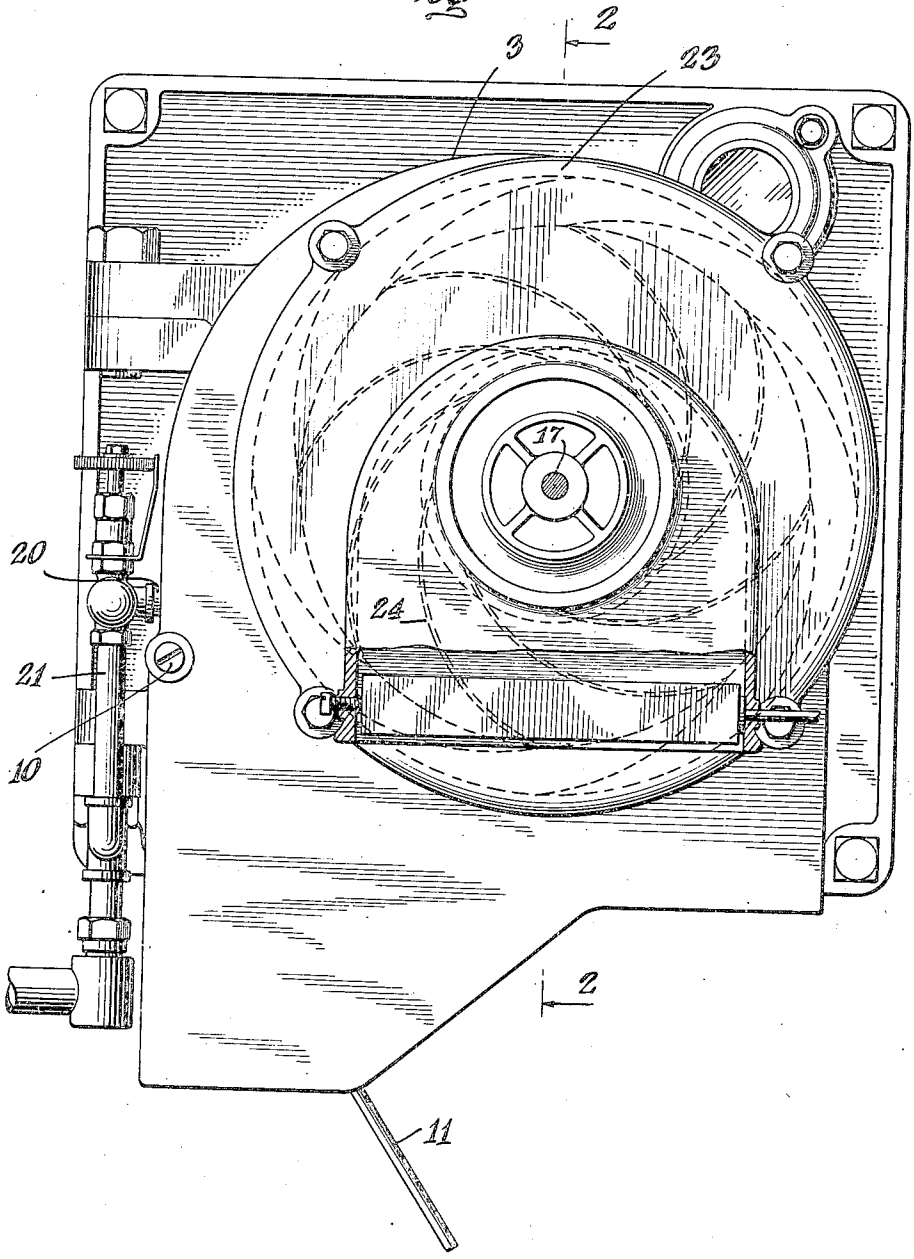

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Fig. 2

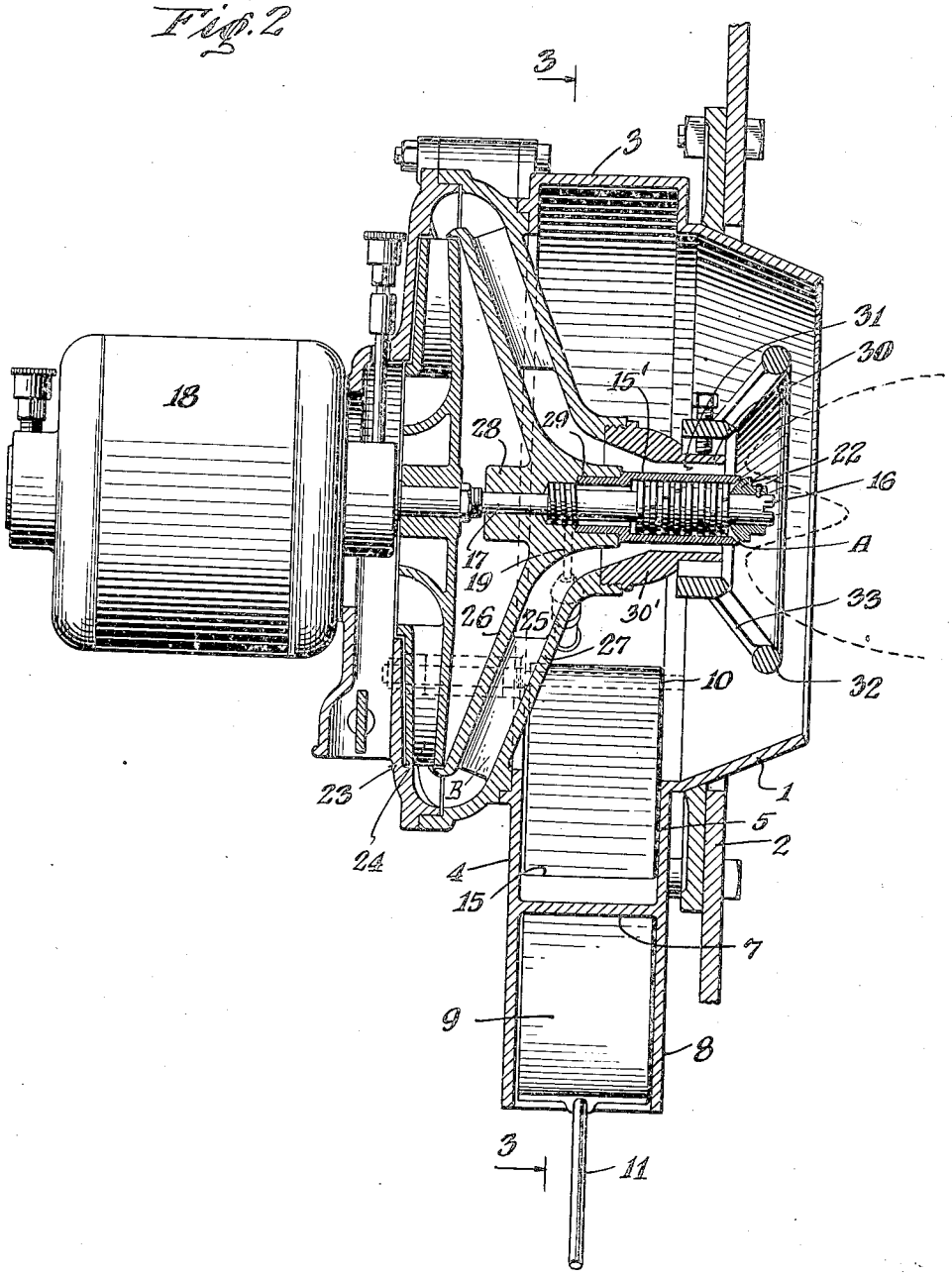

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Fig. 3

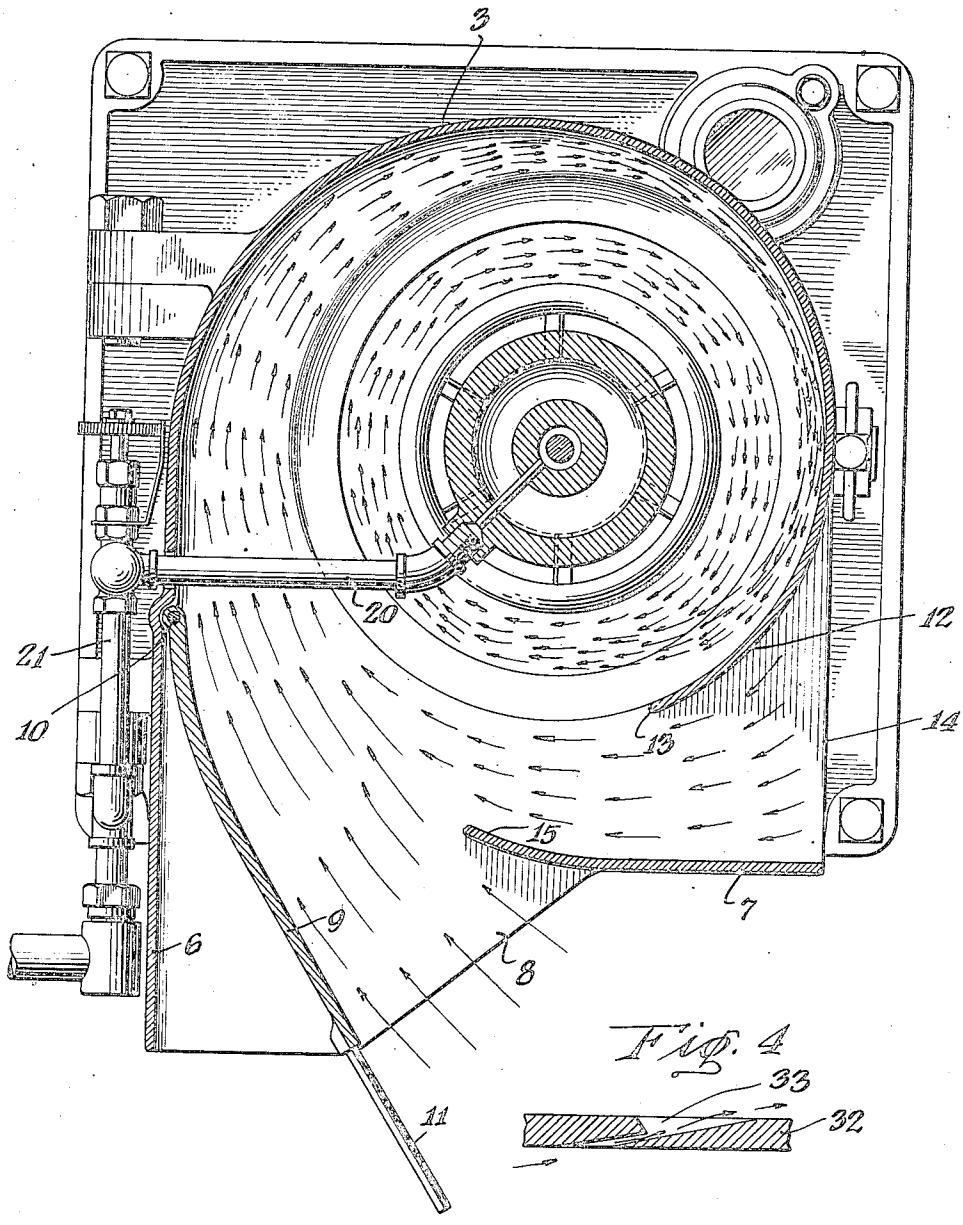

Fig. 4

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UNITED STATES PATENT OFFICE

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METHOD OF LIQUID FUEL COMBUSTION

Application filed February 25, 1931. Serial No. 518,138.

This invention relates to novel means for the delivery to burners of air supplies, both primary and secondary, for the efficient combustion of liquid fuel, and my improvements are directed to the new methods of air delivery involved and to the apparatus employed.

My investigations in liquid fuel combustion have led me to believe that by causing the fuel to issue whirlingly into the combustion zone, and providing a concentric envelope of primary air flowing in contacting relation with the fuel, whirling in the same direction, and joining the fuel at the root of the flame, a condition is set up whereby the fuel and air, spinning at high rotative velocity, are induced to intermingle and blend into a more perfect mixture than has been available by any of the methods in vogue.

This method of associating the fuel and primary air results in the production of a relatively short, bushy flame, whose propagation proceeds whirlingly through an unusually prolonged rotative path, in which the fuel continues to burn in suspension with great efficiency.

The secondary air employed by me is caused to whirl in the same direction of rotation as the primary air and fuel, and is drawn into the flame over a deflector, thereby providing a large volume of air that envelopes the flame and supplies the necessary amount of oxygen to effect complete combustion. The flow of the secondary air is in undivided volume, by which is meant that it enters the furnace throat in a volutely moving mass, instead of being divided into streams by the use of vanes, as has previously been resorted to, and therefore the secondary air is enabled to blend in with the other constituents of the flame.

Other features and advantages of my invention will hereinafter appear.

In the drawings:

Figure 1 is a face view of my improved fuel burning apparatus.

Fig. 2 is a section on the line 2—2 of Fig. 1.

Fig. 3 is a section on the line 3—3 of Fig. 2, and

Fig. 4 is a section through the flame cone.

In the drawings let 1 indicate the usual Venturi ring, which is entered through an opening provided therefor in a furnace front plate 2, said ring 1 being connected with a box-like structure, through which air is supplied to the furnace for combustion purposes. This supply of air is termed the secondary air, and the air box is so constructed that it will cause the air flowing therethrough, under either natural or forced draught, to enter the furnace whirlingly through ring 1, in a volute, undivided volume.

To this end the air box has a partly spiral peripheral wall 3 that, with the ring 1, contains the fuel atomizer and primary air supply means. But, whilst the burner and primary air supply means (which will both be described hereinafter) are centered within the ring 1, they are disposed eccentrically with respect to wall 3, being nearer that portion of the wall whence the flowing air passes into ring 1 than to the portion of the wall where air has its entry into the air box.

The air box is bounded by a forward plate 4 and a rearward plate 5, except that a circular clearance in back plate 5 registers with the larger diameter of ring 1.

The partly spiral form of wall 3 continues from a vertical wall portion 6, which latter, with the forward and rearward plates, 4, 5, and a base 7, provide between them an air inlet 8, that is controlled by a damper 9, hinged at 10 near wall portion 6, and provided with a handle 11 for its operation, whereby the area of the inlet opening may be regulated.

The partly spiral wall in its curvature gradually restricts the area encompassed between it and the circle represented by the larger diameter of ring 1, meeting that circle about in a horizontal plane bisecting said ring, thence continuing in said circle, with wall portion 12, to a point, indicated at 13, approaching a vertical plane transversely bisecting the ring.

Said wall portion 12, plates 4 and 5 and base 7, unite to form a passageway, having inlet 14, for the inflow of additional air into the air box. The base 7 has an upwardly curved extremity 15 to aid in directing the air stream entering inlet 14 into the course

of the air stream entering the air box through inlet 8.

From the foregoing description of the air box formation, with its partly spiral peripheral wall, within which the atomizer and primary air supply means are eccentrically located, and bearing in mind that the inlet portion of the air box is greater in area than the furnace throat represented by the ring 1, and that the area of the air box becomes contracted toward the end of the partly spiral wall 3, then it becomes evident that the stream of air flowing to the furnace through the air box, concentrates in its spiral path and is caused to pass through ring 1 in a volute, whirling volume.

The manner in which this volume of secondary air co-acts with the mixture of fuel and primary air, will be referred to hereinafter, it now being desired to describe the supply means for the fuel and the primary air.

The atomizer employed in my improved fuel burning apparatus, and illustrated herein, forms the subject of a companion case, filed concurrently herewith with Serial No. 518,139, and only such features thereof will be described herein as are necessary for an understanding of the method of fuel combustion comprised in this application.

Thus the atomizer has a casing 15′ that contains a multi-flanged spindle 16 which connects with the shaft 17 of a motor 18 whereby said spindle is driven at high speed. Liquid fuel is introduced into the casing 15′ as by means of a tube 19, which receives its supply from a branch 20 of liquid fuel pipe line 21. The pressure under which liquid fuel is delivered to the atomizer need be only moderate, since the high speed at which the spindle rotates, which may for example be 3500 R. P. M., and the flanges on the spindle, which are spaced apart and provided with staggered communicating notches, drive the fuel whirlingly, and at great velocity, through the atomizer. The spindle is provided with a head 22, having a convex inner surface that lies opposed, in spaced relation to the outer, reamed end of casing 15′, leaving a circularly inclined slit A for the emission of fuel, which thus is caused to issue in a whirling film, having a tendency to flare radially.

It is to correct this latter tendency that I provide means for delivering at the root of the flame a hollow column of primary air, whirling at high speed in the same direction of rotation as the liquid fuel, to thereby restrict the radial area of the flame while permitting flame propagation to be continued in an extended circular path during which the fuel may burn in suspension.

These primary air delivery means comprise a blower like that forming the subject of my patent application Serial No. 484,358, filed September 25, 1930, and is here represented by the casing 23, containing the impeller blades 24, driven by the motor 18. Said casing 23, which may be circular in form, communicates at its periphery with a concavo-convex passageway 25 that is composed by the dished members 26, 27, which are in spaced relation in order to provide the passageway 25. The members 26, 27 are connected by a series of membranes B that lie in the rotating flow path of the air, to thus avoid retarding the speed of flow.

The air box plate 4 is provided with a clearance to permit the projection of members 26, 27 therethrough into the air box, the member 26 having a central boss 28, whose forward portion serves as a bearing for the motor shaft 17, while its rearward portion is provided with an enlarged axial bore 29, to receive the forward portion of atomizer casing 15′. A tubular member 30 is placed concentrically about the atomizer casing 15′, and has a forward enlarged portion 30′ that is in screw threaded engagement with the rearward, terminal portion of member 27, said tubular member 30, with the casing 15′, providing between them an annular passageway 31 that forms a continuation of passageway 25.

Passageway 31 terminates just back of the fuel emission slit A, so that the supply of primary air, which is forced whirlingly by the impeller through passageways 25 and 31, at high speed, issues in a hollow rotating column into contact with the conoidal film of fuel that issues from slit A, the fuel and air both rotating in the same direction and assuming a partly spherical form. The flame produced with this admixture of fuel and air is prevented from tailing out radially by the pressure of air that issues from passageway 31 and contacts with the flame at the root thereof, and because the fuel and air, both whirling in the same direction, circle together through a rotary path of unusual extent and time duration. Because the fuel is in suspension in the zone of maximum heat all through the period of rotative travel, the process of combustion is enabled to be thoroughly performed.

Although the mixture of fuel and primary air, referred to, plus a suitable supply of secondary air affords excellent results, I have found that the addition of the secondary air by the improved supply means hereinbefore described, namely, whereby it is caused to enter the furnace whirlingly in undivided volute volume, rotating in the same direction as that of the fuel and primary air, thereby a perfect blend is effected between the several combustible elements, sufficient oxygen is supplied to support combustion, the speed of rotation is maintained, and the volume of secondary air becomes an enveloping mantle to further restrict the radial tailing off of the

flame, tending instead to confine the flame in a whirling bushy mass of thoroughly blended consuming elements.

A flame cone, indicated at 32 as surrounding the atomizer, performs its part in the general efficiency of the apparatus, said cone providing a restricted, annular path between it and the ring 1 for the major portion of the secondary air, which thus joins the flame in its wider radius, whilst a series of angular slits 33 through the cone serve to supply some secondary air to protect the cone from the intense heat.

The slits 33 are so angled as to maintain for the air passing therethrough the same direction of rotation as the main volume of secondary air, because, as has been previously set forth, the speed of rotation of the combustible elements must not be retarded, and these elements, all whirling in one direction under their own impelling forces, blend perfectly in a homogeneous combustible mass.

Variations within the spirit and scope of my invention are equally comprehended by the foregoing disclosure.

I claim:

1. The method of liquid fuel combustion which consists in creating a hollow whirling film of fuel and adding thereto a hollow, contactingly enclosing concentric column of air, whirling under impelling force in the same direction of rotation as the fuel, enabling the fuel and air to travel together in an extended rotary path, to become finely blended, and burning the blended fuel and air.

2. The method of liquid fuel combustion which consists in creating a hollow whirling film of fuel and adding thereto a hollow, contactingly enclosing concentric column of primary air, whirling under impelling force in the same direction of rotation as the fuel, enabling the fuel and air to travel together in an extended rotary path, to become finely blended, and adding a volute volume of secondary air, enveloping and whirling in the same direction as the fuel and primary air, to accord a partly spherical form thereto, and burning the combined fuel and air supplies.

New York, N. Y. February 2nd, 1931.

HARRY MEACHEM.