

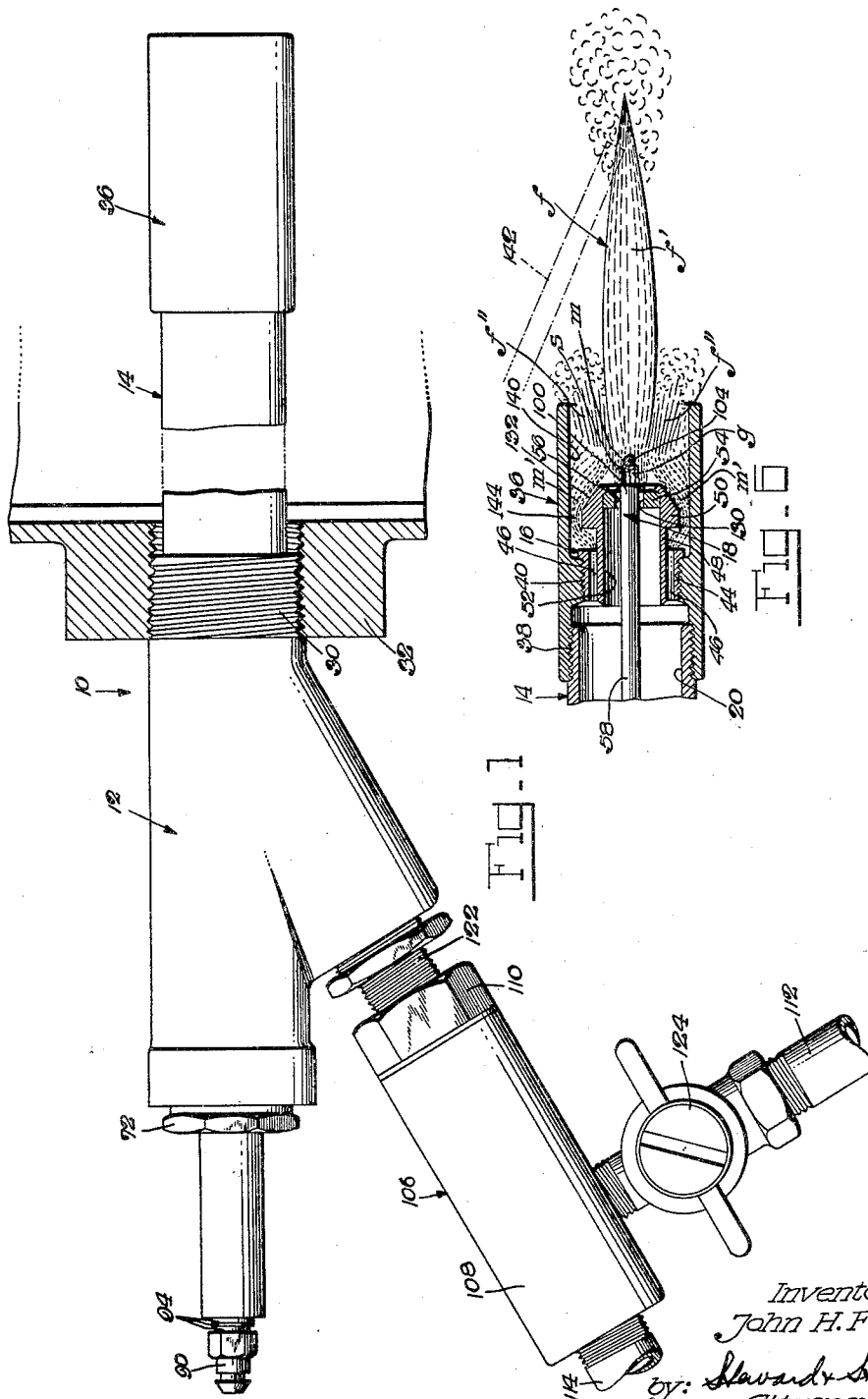
Dec. 25, 1962

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HIGH-VELOCITY FLAME PILOT BURNER OF THE
INTERNAL SPARK-IGNITION TYPE
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Original Filed Nov. 13, 1953

2 Sheets-Sheet 1



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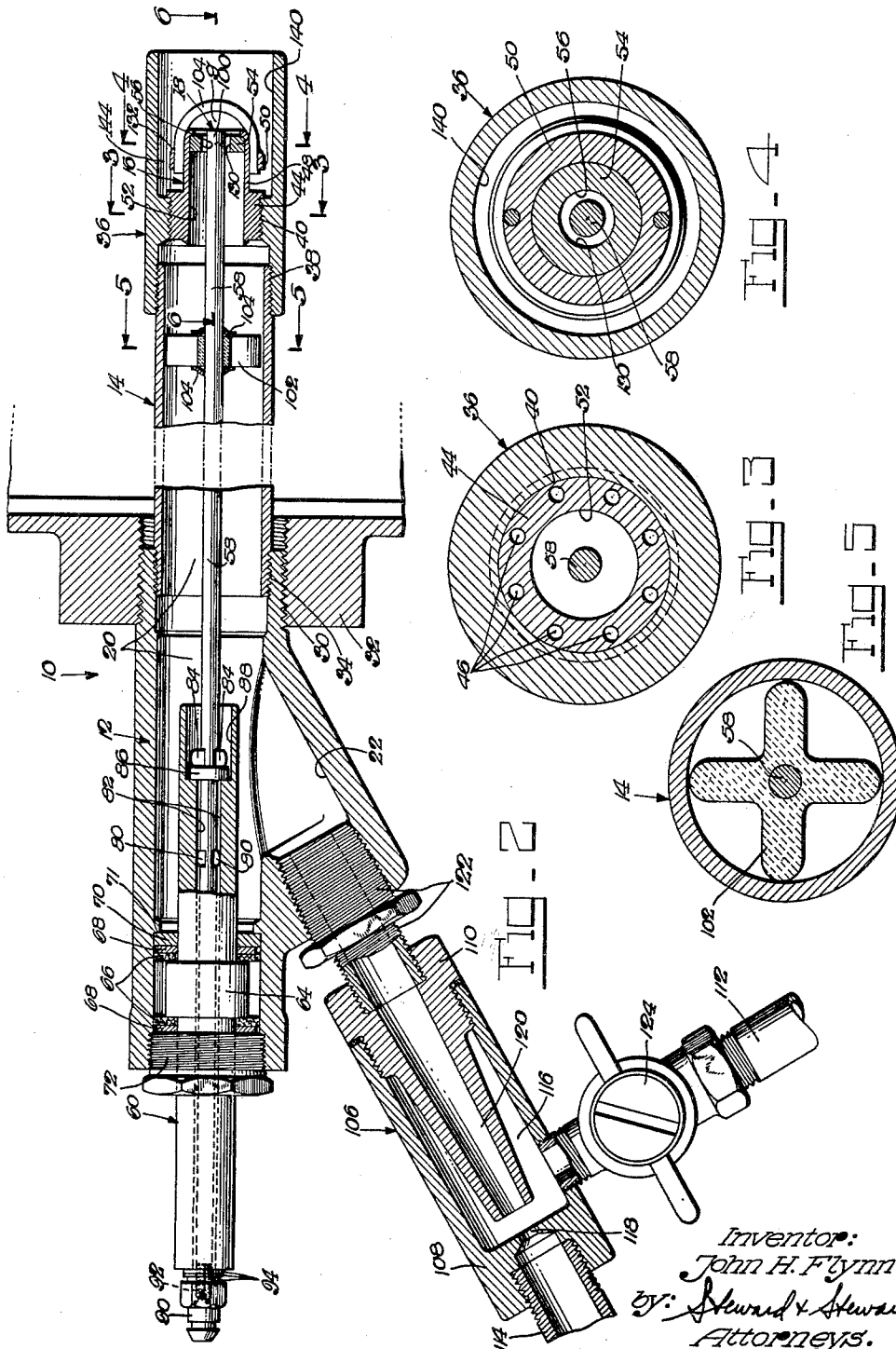
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HIGH-VELOCITY FLAME PILOT BURNER OF THE INTERNAL SPARK-IGNITION TYPE

John H. Flynn, 12 Potter Ave., New Rochelle, N.Y.
Continuation of application Ser. No. 391,845, Nov. 13, 1953. This application Mar. 24, 1960, Ser. No. 17,330
7 Claims. (Cl. 158-115)

This invention relates generally to spark-ignited pilot burners, and more particularly to high-velocity flame pilot burners with internal spark ignition.

This application is a continuation of my co-pending application, Serial No. 391,845, filed November 13, 1953, now abandoned.

High-velocity flames from utility burners as well as from pilot burners therefor are required to withstand air currents of considerable velocity which are intentionally induced in bakery ovens and many other commercial heating installations in order uniformly to distribute the heated air throughout the heating zones involved. To withstand these air currents it is necessary that the gases issuing from the pilot burner have a high velocity, for the higher the velocity of the pilot flame gases the more stable the flame will be. It has been customary in such applications to provide pilot burners in which the velocity of the gases issuing therefrom approach or exceed the speed of flame propagation in the mixture as such flames are very stable and will withstand very strong air currents. However, when the velocity of the pilot flame gases reaches such high values then the flame is not self-sustaining because it travels at a slower speed than the burning gases. Accordingly, such flames will not remain lighted after the initial ignition ceases. Some means, therefore, has to be provided for continuously sustaining the pilot flame after the initial spark ignition has ceased. These means have customarily included secondary or low-velocity flames adjacent the main high-velocity pilot flame. These low-velocity flames serve to continuously ignite the high-velocity flame. The low-velocity flames are self-sustaining because their gas velocities are below the speed of flame propagation and, once the flame is ignited, it continues to burn thereafter. Accordingly, high-velocity flames and the customary low-velocity supporting flames of pilot burners have heretofore been ignited by initially igniting, with sparks, the readily ignitable low-velocity gas jets, whereupon the ensuing low-velocity flames will with certainty ignite the closely proximate high-velocity gas jets and support the ensuing high-velocity flames. All previous attempts at spark-igniting the high-velocity gas jets and relying on the ensuing high-velocity flames to ignite the associated low-velocity gas jets have failed. In order to accomplish initial spark-ignition of the low-velocity gas jets, the spark-ignition is arranged externally of these previous pilot burners with the electrodes located within spark-ignition proximity of the low-velocity gas jets. However, this arrangement of the spark-ignition externally of the pilot burners has been found unsatisfactory due to the early deterioration of the electrodes themselves and of their customarily insulated connectors under the intense heat to which they are constantly subjected in the heating zones for long periods at a time, and the frequent replacement of electrodes and connectors necessitated by their early deterioration.

It is the primary object of the present invention to provide a high-velocity flame pilot burner of the spark-ignition type in which the sparking electrode and the connector thereto are removed from the intense heat in the zone into which the length of the pilot normally extends, thereby to greatly increase the useful life of the electrode and its connector beyond that of previous types, and thus overcome the aforementioned serious deficiency of previous spark-ignition pilot burners.

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Thus, it is among the objects of the present invention to provide a high-velocity flame pilot burner of the spark-ignition type in which the electrode connection is made outside the heating zone into which the pilot extends, and the electrode itself extends internally of the pilot and is effectively cooled by the air-gas mixture flowing through the pilot to the burner head thereof.

It is another object of the present invention to provide a high-velocity flame pilot burner of the spark-ignition type in which the aforementioned internal electrode in the pilot extends into the high-velocity gas jet issuing therefrom and the sparks from the electrode ignite this high-velocity gas jet, thereby not only to enhance the cooling effect of the air-gas mixture on the electrode at its point nearest the flame, but also permit centralized location of the electrode throughout the pilot for maximum cooling effect by the internally flowing air-gas mixture on the entire electrode, as well as for endwise removal of the electrode from, or its installation in, the pilot expeditiously and with the least difficulty.

It is a further object of the present invention to devise a method of igniting the low-velocity gas jet or jets from the associated high-velocity flame immediately after the latter has been ignited by sparks from the aforementioned internal electrode and before these sparks cease, thereby to achieve support of the high-velocity flame from the low-velocity flame or flames without which the former would extinguish as soon as the sparks cease.

Another object of the present invention is to provide in a high-velocity flame pilot burner of the spark-ignition type exceedingly simple structure which, in accordance with the aforementioned method, unfailingly brings about immediate ignition of the low-velocity gas jet or jets by the spark-ignited high-velocity flame.

A further object of the present invention is to provide in a high-velocity flame pilot burner of the aforementioned spark-ignition type a quite substantial contact area between the flame and the burner end of the pilot, thereby to adapt the pilot to the recently developed flame rectification control according to which a control current is conducted from a flame rod through the flame to the pilot and there grounded, and when this current is interrupted at any time at the flame, through accidental extinction or undesired changes in the burning characteristics of the latter from any disturbing cause whatever, control instruments will indicate this fact and the electrode will be charged and the sparks issuing therefrom will reignite the pilot flame as soon as the disturbance is corrected or corrects itself, the current used in this flame rectification control being of the order of a few microamperes and these may, for safer and more reliable performance of the control, be increased the more the larger the contact area of the flame with the pilot is in proportion to the flame's contact area with the flame rod.

Further objects and advantages will appear to those skilled in the art from the following, considered in conjunction with the accompanying drawings.

In the accompanying drawings, in which certain modes of carrying out the present invention are shown for illustrative purposes:

FIG. 1 is a side view of a high-velocity flame pilot burner embodying the internal spark ignition of the present invention;

FIG. 2 is a longitudinal section through the same pilot burner;

FIGS. 3, 4 and 5 are enlarged cross sections through the pilot burner as taken on the lines 3-3, 4-4 and 5-5, respectively, of FIG. 2; and

FIG. 6 is a fragmentary section taken on the line 6-6 of FIG. 2.

Referring to the drawings, and more particularly to FIGS. 1 and 2 thereof, the reference numeral 10 design-

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rates a pilot burner which comprises a burner body 12 with a burner tube extension 14, a burner head 16 and spark ignition means 18. The burner body 12 and tube 14 provide a continuous passage 20, and the burner body 12 is furthermore provided with a lateral branch pas- 5
 sage 22 through which to conduct an air-gas mixture under pressure into and through the passage 20 to the burner head 16 for sustaining a high-velocity pilot flame *f* thereat (FIG. 6).

The instant pilot burner is adapted especially, though not exclusively, for use with high-velocity flame utility burners in bakery ovens or other heating installations having zones of high heat-intensity in which powerful fans uniformly distribute the heated air. Accordingly, the pilot flame of the instant burner must have a high velocity in order safely to withstand the considerable air cur- 10
 rents in these heating installations. Further, the instant burner and more particularly the tube 14 thereof, must be of considerable length in order that the burner be accessible at the outside of a heating installation and extend into igniting relation with a utility burner or burners in the heating zone therein. To this end, the body 12 of the instant burner is at one end threaded as at 30 for its re- 20
 movable mounting in a suitable anchor plate 32 on the outside of a heating installation, with the burner tube 14 and the burner head 16 thereon extending into the heating zone of the installation.

One end of the burner tube 14 is conveniently threaded at 34 for its removable mounting in the burner body 12, while the burner head 16 is, through intermediation of a nozzle 36, mounted on the other end of the burner tube 14. The nozzle 36, which serves for a purpose to be de- 30
 scribed hereinafter, is in this instance screwed at 38 onto the adjacent end of the burner tube 14, and is provided intermediate its ends with a tapped hole 40 for the threaded reception of the body 44 of the burner head 16. The body 44 of the burner head 16, which constitutes the downstream end or terminus of the passage 20, is pro- 35
 vided with a plurality of burner ports 46 (FIGS. 3 and 6) which are preferably arranged concentrically about the axis of the burner tube 14, and are in communication with the passage 20 therein. The body 44 of the burner head 16 is also provided with a shank 48 which at its forward end has an enlarged collar formation 50 (FIGS. 2 and 6). The burner head 16 is provided with a central recess 52 which in this instance holds an insert 54 hav- 40
 ing a central burner port 56 which is also in communication with the passage 20 in the burner tube 14. The arrangement of the ports in head 16 is such that the central port 56 is surrounded by the ports 46 whose downstream termini are located slightly upstream of the terminus of the high-velocity port 56, for reasons which are explained hereinafter.

The spark ignition means 18 includes an electrode 53 which is in the form of a rod and is carried by a holder 60 of any suitable electric-insulating and heat-resistant material, such as ceramic, for instance. The holder 60, being in the form of a sleeve in which the electrode 53 is received, is provided intermediate its ends with a mounting collar 64 which through intermediation of washers 66, 68 and 70 is held against an internal shoulder 71 in the burner body 12 by means of a lock nut 72 (FIG. 2). At least the collars 64 are preferably of relatively soft material to take up differential expansion under heat of the burner body 12 and holder 60 without any adverse effect on the latter. The lock nut 72 and the washer 70 further serve to center the holder 60 and, hence, also the electrode 58 in the passage 20, while the washers 68, being preferably of copper, serve also to seal the rear end of the passage 20 against leakage of the air-gas mixture therethrough. The electrode 53 is thus mounted in the burner body 12 in electrically insulated fashion.

The electrode 53 is received with a sliding fit in the sleeve-like holder 60, but is held against rotation therein by a key or keys 80 which project into longitudinal 75

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grooves 82 in the holder (FIG. 2). The keys 80 may conveniently be swaged from the wire stock of which the electrode 53 is formed. The electrode 53 is held against axial movement in its holder 60 by stop lugs 84 which are held against a metal washer 86 in a recess 88 in the holder by a terminal 90 that is threadedly received by the outer end 92 of the electrode. Like the keys 80, the stop lugs 84 are also conveniently swaged from the wire stock of the electrode 53. Preferably interposed between the terminal 90 and the adjacent end of the electrode holder 60 are washers 94 of which at least one is sufficiently yielding to take up differential expansion under heat of the holder 60 and electrode 53. The terminal 90 serves as a connector for a conductor from any suitable electric power source.

The forward or spark end 100 of the electrode 53 extends into the burner port 56, terminating substantially concentrically thereof closely adjacent the downstream end or face of said high-velocity port, but must under no circumstances contact the wall of this burner port as this would of course result in short-circuiting of the electrode. Since the electrode 53 is of considerable length as explained, and since its holder 60 is quite removed from the burner head 16 and may not with any certainty hold the electrode from contact with the wall of the burner port 56, there is provided near the burner head 16 a spacer 102 which is held on the electrode 53 by self- 25
 locking washers 105. This spacer 102 is received in the burner tube 14 with such slight clearance as to permit the compressed air-gas mixture escaping through the burner port 56 accurately to center the spark end 100 of the electrode therein, yet prevent contact of the latter with this port under any circumstances. The spacer 102, which is preferably made of a high heat-resistant material, such as ceramic, for instance, is in this instance star-shaped (FIG. 5) so as not to impede the flow of the air-gas mixture through the passage 20.

Arranged in downstream relation with the electrode 53, which is a sparking electrode, is a grounding electrode 104 which is arc-shaped and in this instance mounted with both ends in the collar formation 50 on the burner head 16 (FIG. 2). The electrode 104 is thus electrically connected with the burner head 16 and burner tube 14 for grounding sparks emanating from the electrode 53 and jumping the spark gap *g*.

The air-gas mixture for the burner is formed in a mixer 106 which in this instance consists of two complementary parts 108 and 110 (FIG. 2). Conduits 112 and 114 serve for the introduction of gas and compressed air, respectively, into a mixing chamber 116. Provided in the mixer 106 in the path of the admitted compressed air is a constricted passage 118, followed a short distance therefrom by an outlet tube 120 which through a fitting 122 is in communication with the branch passage 22 in the burner body 12. The compressed air admitted through the constricted passage 118 has a sufficiently high velocity to have a Venturi effect on the surrounding gas in the mixing chamber 116 and suck into the outlet tube 120 a sufficient amount of this gas to form therewith a highly flammable mixture which for the sake of brevity is referred to as "gas" throughout the rest of the specification. Manual valves, one being shown at 124 in FIGS. 1 and 2, are preferably provided to permit opening and closing of the gas and air conduits 112 and 114. The branch passage 22 in the burner body 12 forms such a slight angle with the main passage 20 therein (FIG. 2) that the gas will have a practically unobstructed flow into the latter and substantially maintain its velocity throughout the burner.

In operation, gas from the mixer 106 flows at considerable velocity through the passages 22 and 20 in the burner body 12 and burner tube 14 to the burner head 16 where it escapes through the burner ports 56 and 46. The sparking electrode 53 may then be connected for a brief interval with the electric power source for the pro-

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duction of sparks *s* (FIG. 6) some of which jump from the sparking electrode 58 to the wall 130 of the high-velocity port 56 and some of which jump the gap *g* to be grounded through the grounding electrode 104. The sparks *s* thus emanating from the electrode 58 ignite the gas escaping from the burner ports 56 and 46. The ensuing flame *f* is of the high-velocity and high heat-intensity type and is composed of a high-velocity jet flame *f'* of considerable length and a plurality of secondary or low-velocity flames *f''* which support the high-velocity jet flame *f'*. The high-velocity jet flame *f'* emanates from the central high-velocity burner port 56, while the low-velocity flames *f''* emanate from the low-velocity burner ports 46. As the high-velocity designation of the central burner port 56 indicates, the gas *m* escaping therethrough (FIG. 6) has considerably higher velocity than the gas *m'* escaping through the low-velocity ports 46. This is due to the fact that despite the extension of the sparking electrode 58 into the central burner port 56 the clear cross-sectional area of the latter is considerably larger than that of any of the low-velocity burner ports 46.

It is, of course, the internal arrangement of the sparking electrode 58 in the instant pilot burner which achieves the aforementioned objective of lending to this electrode and its connector a useful life which is incomparably longer than that of previous sparking electrodes and their connectors. Thus, the centralized location of the sparking electrode 58 in the instant burner results not only in maximum spacing of the former from the heat-exposed walls of the latter, but also in maximum cooling of this electrode by the surrounding gas as it flows at considerable velocity through the burner. Moreover, and in further distinct contrast to the connectors of previous sparking electrodes for pilot burners of this type, the connector used for the instant sparking electrode is, by virtue of the internal arrangement of the latter, connected with the electrode on the outside of the heating installation and is, therefore not at all subjected to heat.

When no gas flows through the burner, all sparks emanating from the electrode 58 will follow the path of least resistance and jump the narrow gap between the spark end 100 of this electrode and the wall 130 of the insert 54 forming the high-velocity burner port 56. However, when gas *m* of any appreciable velocity, and especially of the high-velocity contemplated, passes through the burner port 56, substantially all sparks *s* emanating from the electrode 58 will be blown by this gas against the grounding electrode 104 in a path in more or less direct alignment with the electrode 58 (FIG. 6). However, some sparks will still jump the narrow gap between the electrode 58 and the wall 130. Accordingly, the sparks *s* from the electrode 58 are thus kept more or less wholly within the confines of the high-velocity gas *m* that emerges from the burner port 56.

Considerable difficulty was encountered in igniting the flame *f* on brief production of sparks by the electrode 58 and thereafter sustaining the flame. Thus, while these sparks partly ignited the high-velocity gas *m* in the immediate vicinity of the burner port 56, they did not ignite the low-velocity gas *m'* emerging from the secondary burner ports 46, with the result that the high-velocity flame *f'* became extinguished immediately after the electrode ceased spark production. Hence, in order that the high-velocity jet flame *f'* may, after its spark ignition, be maintained in the only way known, namely by the secondary or low-velocity flames *f''*, it became imperative to effect ignition of the low-velocity gas *m'* from the secondary burner ports 46 simultaneously with the spark ignition of the high-velocity gas *m* from the main burner port 56. After many trials and errors, this problem was solved by the discovery that the low-velocity gas *m'* from the secondary burner ports 46 will readily ignite if at least a part of this low-velocity gas is admitted into fairly close proximity to the spark-ignited high-velocity gas *m* from the main burner port 56. While no theory is herein

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advanced as to why the low-velocity gas from the secondary burner ports will ignite under these circumstances, it is believed that that part of the low-velocity gas *m'* which is admitted into close proximity to the high-velocity gas *m* is drawn into a partial vacuum created around the latter due to its high-velocity, and intermingles with some of the high-velocity gas sufficiently to propagate the spark-ignited high-velocity flame *f'* to the low-pressure gas *m'*. Many expediences suggest themselves to achieve the flow of a part of the low-velocity gas *m'* from the secondary burner ports 46 into close proximity to the high-velocity gas *m* from the main burner port 56 in the region within which the former is ignited by sparks *s* from the electrode 58. Thus, the secondary burner ports 46 may be arranged so closely to the main burner port 56 that part of the low-velocity gas emerging from the former will flow into close proximity to the high-velocity gas emerging from the latter. In the present instance, the collar formation 50 on the burner head 16 is at its front formed frusto-conical as at 132 so as to permit the low-velocity gas *m'* from the secondary burner ports 46 to expand into close proximity to the high-velocity gas *m* from the main burner port 56 as shown in FIG. 6. Thus, it is the underlying method of directing a part of the low-velocity gas from the secondary ports 46 into close proximity to the high-velocity gas from the main burner port 56 which brings about assured and instantaneous ignition of the high-velocity and low-velocity components *f'* and *f''* of the flame *f* by sparks entirely within the confines of the high-velocity gas *m* and assured maintenance of these flame components *f'* and *f''* after spark production by the electrode 58 has ceased.

The before-mentioned nozzle 36 is provided to achieve the aforementioned objective of ready adaptation of the instant pilot burner to the recently developed flame rectification control. To achieve the substantial grounding area between the flame and the burner required by this flame rectification control in order to permit, for safer and more reliable performance of the control, the use of a current of a maximum number of microamperes, the nozzle 36 has a cylindrical flame contact area 140 of considerable extent. The control current is by a flame rod 142 (indicated in dot-and-dash lines in FIG. 6) applied to the flame *f* which conducts this current to the nozzle 36 where it is grounded. As shown in FIG. 6, the collar formation 50 on the burner head 16 extends into fairly close proximity to the cylindrical surface or flame contact area 140 of the nozzle to form a somewhat constricted annular passage 144 from which the emerging low-velocity gas *m'* will in part flow from along this cylindrical nozzle surface and support the low-velocity flames *f''* in a disposition in which they sweep a maximum area of this cylindrical nozzle surface. On the other hand, the frusto-conical formation of the front face 132 of the collar formation 50 on the burner head 16 permits a sufficient amount of the low-velocity gas *m'* to expand into close proximity to and be drawn into the high-velocity gas *m* near its emergence from the main burner port 56 to achieve the aforementioned simultaneous ignition of the high-velocity and low-velocity gas jets *m* and *m'* from the main and secondary burner ports 56 and 46 on spark production by the electrode 58, and assured maintenance of the ignited flame components *f'* and *f''* after spark production by the electrode 58 has ceased.

The invention may be carried out in other specific ways than those herein set forth without departing from the spirit and essential characteristics of the invention, and the present embodiments are, therefore, to be considered in all respects as illustrative and not restrictive, and all changes coming within the meaning and equivalency range of the appended claims are intended to be embraced herein.

What is claimed is:

1. A high-velocity flame pilot burner having internal

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spark ignition comprising a tubular burner body providing a longitudinal passage for the flow of a combustible air-gas mixture therethrough, said body having inlet means at its upstream end for introducing said air-gas mixture under pressure; a burner head at the downstream end of said passage, said head having a high-velocity port located centrally of said passage and a plurality of low-velocity ports in circularly spaced arrangement about said high-velocity port; a sparking electrode in said passage electrically insulated from said body, the tip of said electrode extending centrally into said high-velocity port and terminating substantially in the plane perpendicular to the axis of said last named port at the downstream end thereof to define a spark gap with said high-velocity port and a grounding electrode secured to said burner head transversely and downstream of said high-velocity port.

2. A high-velocity flame pilot burner as defined in claim 1, wherein said burner head is formed to provide an external frusto-conical collar, the conical surface thereof being tapered toward the downstream end of said high-velocity port to dispose the smaller base of said collar in said perpendicular plane, said low-velocity ports terminating upstream of the large base of said collar.

3. A high-velocity flame pilot burner as defined in claim 2, wherein said grounding electrode is of thin arcuate shape and is secured at its opposite ends to said collar to extend diametrically across said high-velocity port in closely spaced relation to the end of said electrode.

4. A high-velocity flame pilot burner as defined in claim 1, which further includes a grounding nozzle adapting said burner for flame recitification control, said nozzle being electrically connected with said burner head and extending axially beyond the downstream end thereof and closely surrounding said low-velocity ports whereby flames issuing from said ports will sweep along and in contact with a substantial surface area of said nozzle.

5. A high-velocity flame pilot burner as defined in claim 4, wherein said burner head is formed to provide an external frusto-conical collar, the conical surface thereof being tapered toward the downstream end of said high-velocity port to dispose the smaller base of said col-

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lar in said perpendicular plane, said low-velocity ports terminating upstream of the larger base of said collar.

6. A high-velocity flame pilot burner as defined in claim 4, in which said nozzle is removably mounted on the downstream end of said longitudinal passage in said burner body and said burner head is mounted in said nozzle whereby said nozzle and burner head are removable as a unit from said body.

7. A high-velocity flame pilot burner of the spark-ignition type, comprising a tubular burner body providing a longitudinal passage for the flow of combustible air-gas mixture therethrough, said body having inlet means at its upstream end for introducing said air-gas mixture under pressure; a burner head at the downstream end of said passage, said head having a high-velocity port located centrally of said passage and low-velocity port means surrounding said high-velocity port and terminating in a point closely upstream thereof; a sparking electrode supported in said passage and electrically insulated from said body, said electrode extending into said high-velocity port substantially concentrically thereof and terminating substantially at the downstream end of said high-velocity port whereby said electrode forms a spark gap with said high-velocity port; and an insulating spacer on said sparking electrode received in said passage and having apertures for the flow of said air-gas mixture through said passage, said spacer supporting the downstream end of said sparking electrode in said high-velocity port to prevent contact between them, but having a sufficiently loose fit in said passage to permit it to be centered in said high-velocity port by the flow of gas therethrough.

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