Nov. 14, 1950 G. L. HELLER 2,529,873

MANUFACTURE OF CARBON BLACK

Filed Jan. 15, 1948 4 Sheets-Sheet 1

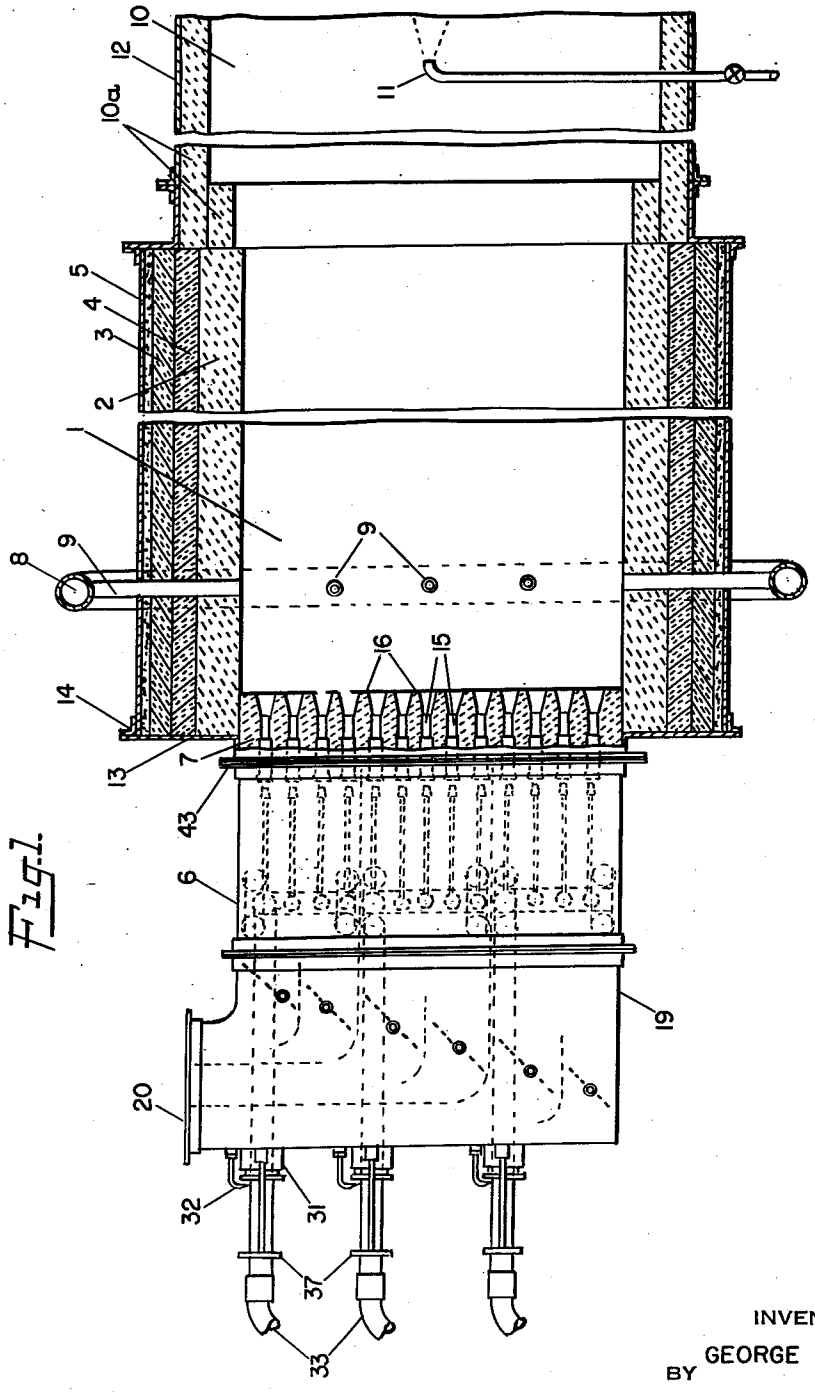


Fig. 1.

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MANUFACTURE OF CARBON BLACK

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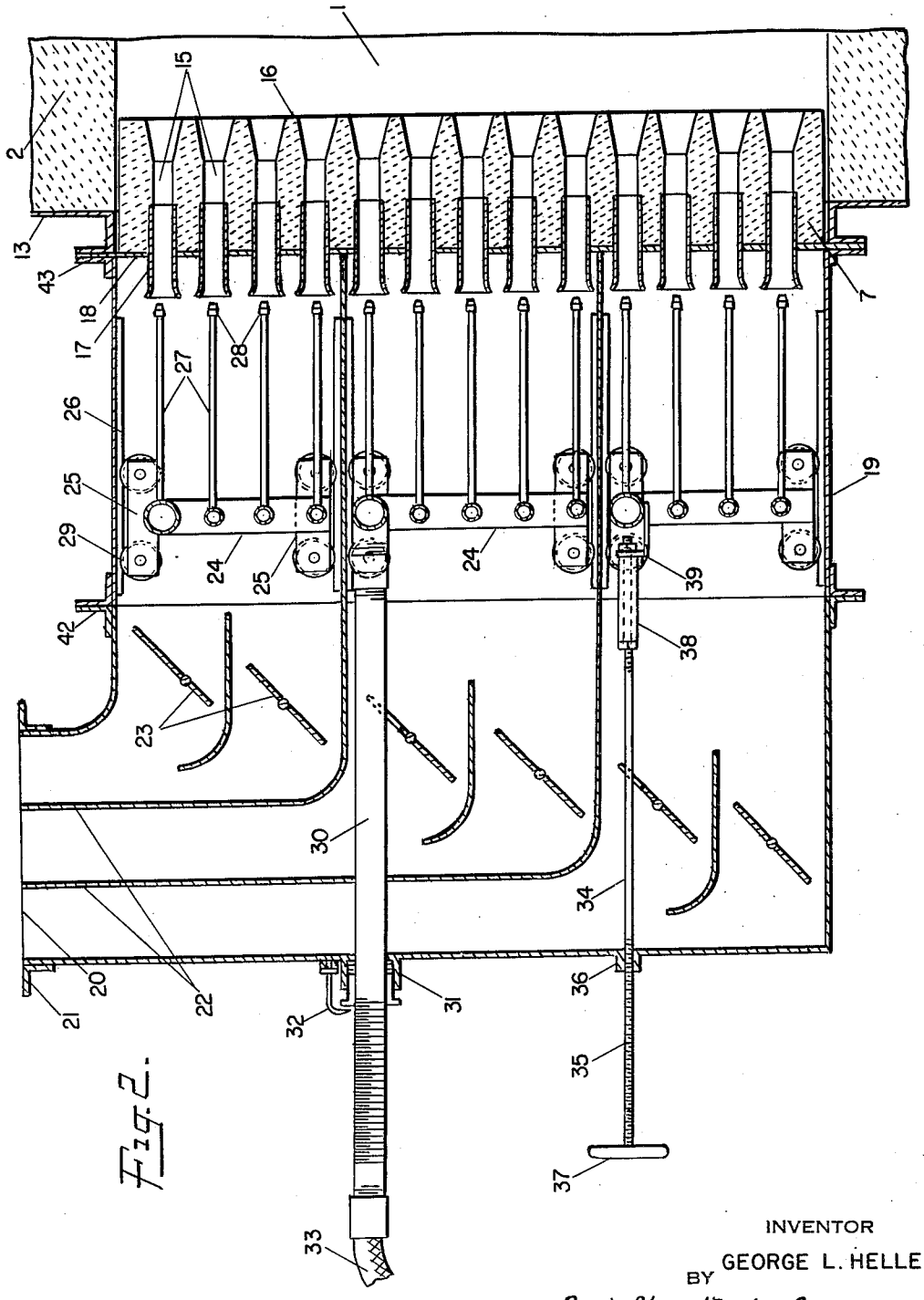


Fig. 2.

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MANUFACTURE OF CARBON BLACK

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Fig. 3.

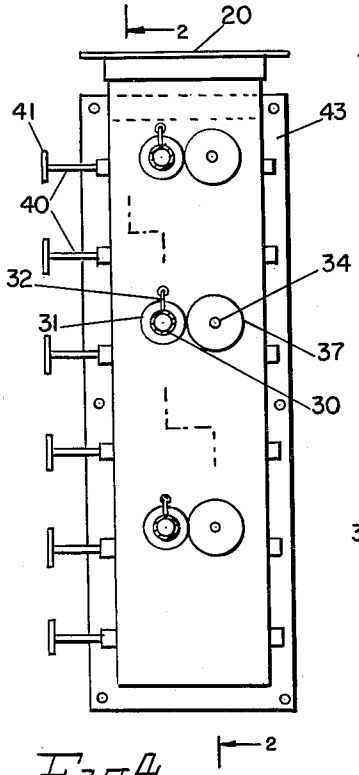


Fig. 6.

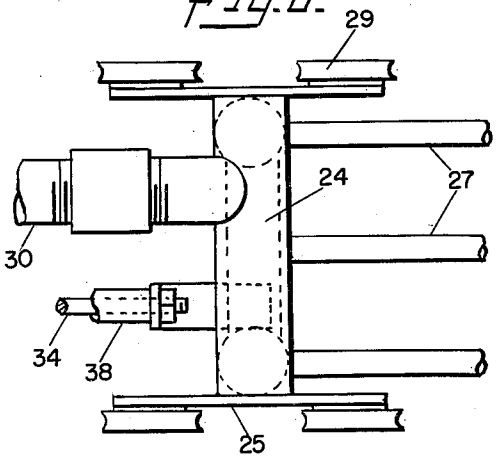


Fig. 4.

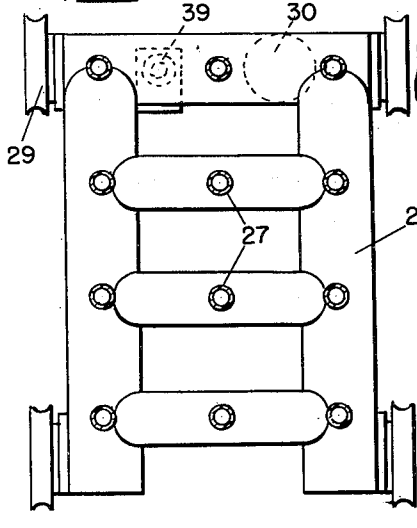
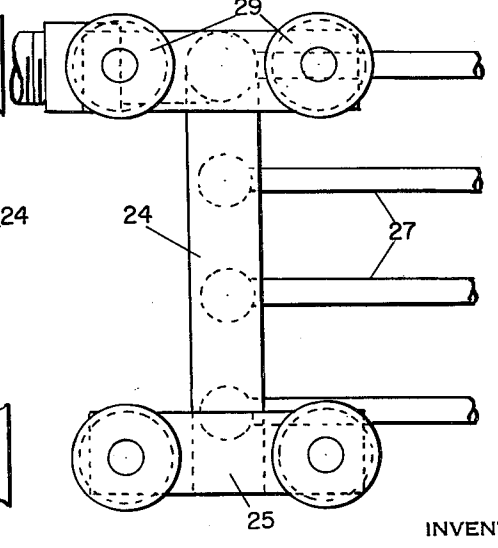


Fig. 5.



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MANUFACTURE OF CARBON BLACK

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Fig. 7.

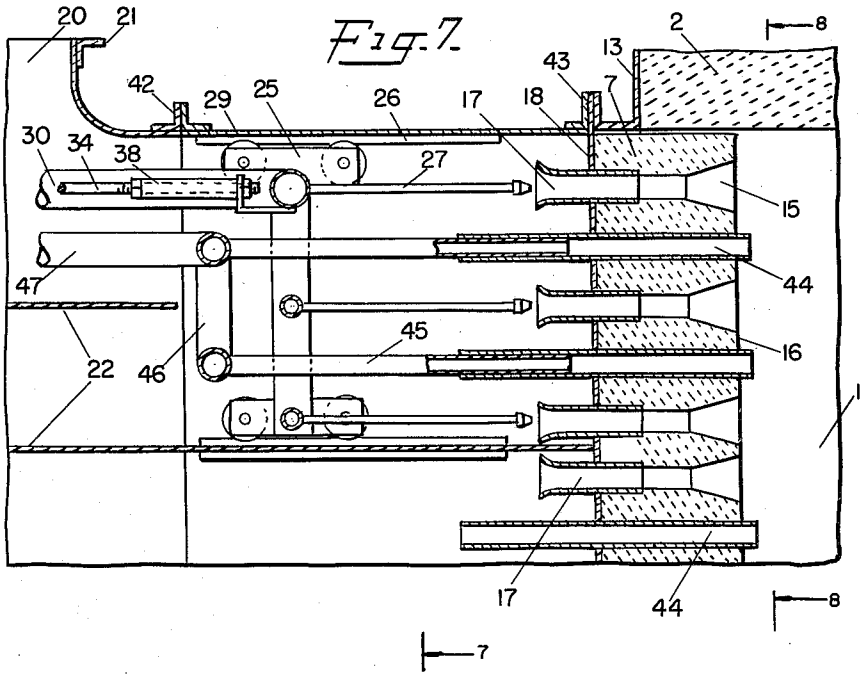
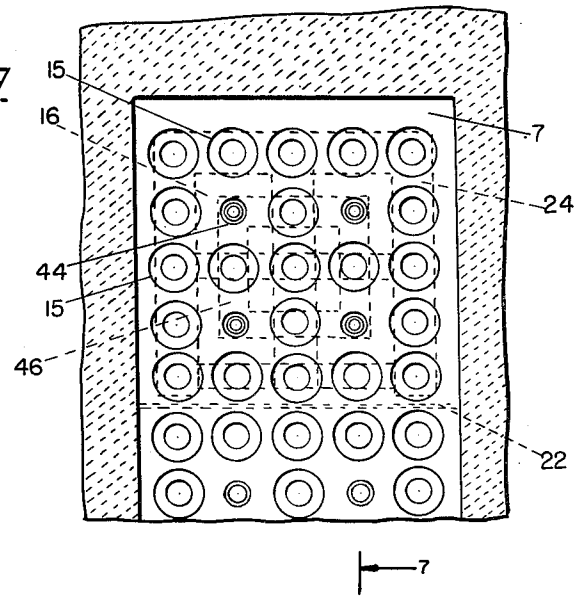


Fig. 8.



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UNITED STATES PATENT OFFICE

2,529,873

MANUFACTURE OF CARBON BLACK

George L. Heller, Monroe, La., assignor to Columbian Carbon Company

Application January 15, 1948, Serial No. 2,399

11 Claims. (Cl. 23—209.8)

1

This invention relates to an improved blast burner of especial utility where very high rates of combustion are required as, for example, in the manufacture of carbon black by a process employing a highly turbulent, high velocity blast flame such, for instance, as described in patent No. 2,378,055, granted June 12, 1945, on an application of Wiegand and Braendle.

In the process described in said patent, a violently turbulent stream of blast flame gases is projected at high velocity into one end of an elongated, unobstructed chamber and a stream, or streams, of hydrocarbon gas to be decomposed to form the carbon black separately and forcefully injected into the hot, highly turbulent blast flame gases. The blast flame is, with advantage, produced by blasting a combustible mixture of fuel gas and air through a plurality of ports, advantageously of substantially uniform transverse section over a major portion of their depth, extending through a burner block of substantial depth, say 9 to 12 inches thick, positioned in the upstream end of the chamber, and burning the mixture as it enters the chamber. A particularly advantageous method of mixing and injecting the combustible mixture into the chamber is to force air under pressure through the burner ports from a so-called wind-box enclosing the upstream end of the burner ports and separately jetting a stream of fuel gas into each of the air streams as it enters the burner port, or in an early stage of its passage through the port.

My present invention provides improved apparatus for carrying out, and an improved method of starting-up, an operation such as there described and also provides an improved blast burner particularly adapted to the carrying out of the operation, including the starting-up period.

Processes of the general type described have been used with marked success in the manufacture of certain desirable types of furnace blacks and especially advantageous results with respect to character and yield of the resultant black have been attained where the fuel gas is injected into the streams of combustion air as the latter pass through the early or mid portion of the burner port.

In large commercial sized apparatus, a large number of burner ports leading into the reaction chamber from a common wind-box is usually employed, each equipped with a fuel gas jet, or so-called spud, connected in groups to a common fuel gas manifold or header. Most effective operation is usually attained where these spuds are positioned, during normal operation, not more

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than about one-quarter of the way through the burner ports, generally somewhat further upstream, and coaxially positioned with respect to the burner ports.

It has been recognized that some leeway is permissible with respect to the positioning of the spud relative to the inlet to the burner port, but most advantageous operation with respect to character and yield of the product has been attained with the spuds in the position just described.

In operation, the described process has been found to proceed smoothly with infrequent interruption, though some minor adjustment of the position of the spuds may from time to time be desirable. However, in lighting and starting-up a cold furnace, and before the burner block face and furnace walls have become adequately heated, considerable difficulty has been experienced. Frequently, a series of minor explosions will occur which rather violently shake the furnace and tend to weaken its structure. It appears that, under relatively cold furnace conditions, the high velocity of the entering combustion mixture caused the combustion gas to travel a substantial distance from the burner block face before igniting. Within the chamber to the rear of the flame front, there is a relatively large volume of a combustible mixture of fuel gas and air which appears periodically to ignite with violence.

My present invention provides a method and means for lighting and starting-up a cold furnace, whereby difficulty in operations of the type described is avoided. I have discovered that if in starting a cold furnace, the fuel gas be injected into the air streams at a point near the downstream end of the burner block ports, this difficulty is entirely avoided. Under such conditions, the flame front has been found to be a substantial distance downstream from the burner block face, as in starting the furnace with the spuds in the normal operating position, nevertheless, the previously described explosions are avoided.

Predicated upon my discovery, in starting a cold furnace, in accordance with my present invention, the fuel gas injection spuds are moved forward from their normal operating position to a position at least half-way through the ports and usually to a point at approximately the outlet end of the ports and kept in that position until the face of the burner block has been heated to above the ignition temperature of the combustible mixture. Thereafter, the spuds are

retracted, advantageously gradually, back through the burner block ports, with a resultant drawing of the flame back against the face of the burner block. After the spuds have thus been returned to their normal operating position, normal operation of the process is carried on.

My invention provides the safety and convenience of an inspirator type burner with the efficiency of a premixed air and gas burner and provides an improved blast burner adapted to efficient operation over wide ranges of load and ratios of air to gas not heretofore attainable.

In advancing the spuds to the starting position, in accordance with the present invention, undue interference with the flow of air through the burner block ports must be avoided. The invention provides an improved burner head adapted to the carrying out of the starting-up operation as well as the normal operation of the furnace. In this improved apparatus, the spuds are of substantially smaller diameter than the smallest diameter of the burner block ports and are connected to a fuel gas manifold by tubes, or similar rigid conduits, of a length substantially greater than the depth of the burner block, so as to permit their forward movement through the burner block ports to a position near the outlet end thereof without undue interference by the fuel gas manifold with the flow of air into the ports from the wind-box.

The spuds and connecting lines are, with advantage, rigidly supported solely by the fuel gas manifold, though additional supports may be supplied, providing they do not interfere with the free flow of air to the ports. The fuel gas manifold is, with advantage, positioned within the wind-box and is so constructed and arranged as to be movable back and forth through the wind-box so as to adjust the positions of the spuds.

The burner block ports should not exceed 2 inches in diameter and are with advantage within the range of 1 to 1⅝ inches i. d. The depth of the ports should be at least four times their diameter and, advantageously, five to twelve times their diameter. The discharge end of the ports may be flared somewhat to allow some decrease in velocity at the point of combustion, but it is advantageous that at least 50% of the area of the burner block face be a relatively plane surface. The ports should be at least 4 inches in depth.

The spuds are, with advantage, of an over-all diameter not exceeding one-half that of the burner ports with an inside diameter of about ⅛ to $\frac{5}{32}$ inch, and so designed as to project a gaseous cone of fuel gas of less than 30° included angle, advantageously, 10° to 20°.

The blast burner of the present invention is not to be confused with burners of the inspirator type which involve the jetting of a stream of fuel into and through an air inlet, usually flared or bell-shaped, which is open to the atmosphere at its upstream end and through which the fuel stream sucks in an amount of air required for combustion. In such burners, the efficiency of inspiration and mixing is recognized to be a function of the position of the fuel nozzle with respect to the air inlet.

The present invention relates to improvements in burners of a distinctly different type in which the air for combustion is supplied through a wind-box under super-atmospheric pressure independently of inspiration by the fuel stream.

The invention will be further described and illustrated by reference to the accompanying drawings which represent a particularly advantageous embodiment of the invention in apparatus comprising three separately adjustable banks of spuds. It will be understood, however, that the invention is not so restricted, but is applicable generally to high velocity blast burner heads employing a plurality of burner ports.

Referring to the drawings—

Figure 1 represents, conventionally and somewhat diagrammatically, a fragmentary vertical, longitudinal sectional view of a carbon black furnace of rectangular cross-section and having a blast burner head with 39 burner ports;

Figure 2 is a somewhat enlarged vertical section of the blast burner head of Figure 1 along the line 2—2 of Figure 3;

Figure 3 is an enlarged end view of the burner head looking toward the furnace;

Figure 4 is an enlarged detailed end view of the fuel gas manifold;

Figure 5 is a side view of the manifold of Figure 4;

Figure 6 is a plan view of the manifold of Figure 4;

Figure 7 is a fragmentary vertical sectional view along line 7—7 of Figure 8 of a modified form of a burner head including means for injecting the make gas into the furnace; and

Figure 8 is an end view of the burner block of Figure 7 from the furnace end.

Referring more particularly to Figure 1 of the drawings, the part indicated by the reference numeral 1 is a horizontally elongated, rectangular furnace chamber, lined with firebrick 2. Surrounding the layer of firebrick are two outer layers of insulating material 3 and 4, respectively, all encased in a sheet metal shell 5. Positioned at the forward end of chamber 1 is the blast burner head 6, more clearly shown in Figure 2 of the drawings, the burner block 7 of the burner head being coextensive with the transverse area of the chamber and of such dimension as to slide into the forward end of the chamber 1 and is sealed therein by conventional means.

In operation, a mixture of fuel gas and air is passed at high velocity into the upstream end of chamber 1, as hereinafter more fully described, and is ignited and burned therein to form a violently turbulent blast flame. The hydrocarbon to be decomposed to form carbon black, herein designated make gas, is passed from a suitable source and under super-atmospheric pressure, into manifold 8 which is connected with the interior of the chamber by a plurality of tubes 9 projecting inwardly through the furnace walls.

The make gas is thus forcefully injected through tubes 9 into the violently turbulent stream of blast flame gases coursing through the chamber, is quickly and thoroughly mixed with the hot blast flame gases and is decomposed by heat contained therein.

Chamber 1 is of substantial length, sufficient to provide the necessary decomposition time factor, say 5 to 10 feet, is free from obstructions, and is of substantially uniform transverse dimensions throughout its length. The resultant mixture of blast flame gases, make gas, and decomposition products thereof, continue through the chamber at high velocity and high turbulence and passed therefrom into chamber 10 wherein it is cooled by one or more water sprays, indicated at 11, and from which it passes to separating apparatus, not shown, adapted to recover the resultant carbon

black from the effluent furnace gases. The chamber 10 is likewise lined with firebrick 10a and is encased by the sheet metal casing 12.

The burner head 6, more clearly shown in Figure 2 of the drawings, is secured to the furnace structure by means of a front metal plate 13, which is, in turn, fastened to the metal casing 5 of the furnace by flanges or angle irons indicated at 14.

The burner block 7 is of refractory material and extending therethrough is a plurality of substantially cylindrical burner ports 15, the respective ports being somewhat flared at their downstream end and so positioned and constructed as to leave a substantial burner block face area 16 between the ports. At their upstream end, the respective burner ports are provided with metal tubes 17, slightly flared at their inlet end and securely held in the burner ports by means of metal plate 18 to which they are fastened, as by welding. The tubes 17 are also, with advantage, cemented into the burner ports so as to secure a tight fit. It will be understood that subsequent reference herein to the burner ports or burner block ports is intended to include the metal tubes 17, as well as the ports 15 extending through the burner block proper.

The burner ports, open at their upstream end into the wind-box 19. Air for supporting combustion is forced under super-atmospheric pressure into the upstream end of the wind-box through air inlet 20, which is connected with a blower, or the like and metering system not shown, by means of flanges 21. Air is thus forced at high velocity through the respective burner ports. In order to secure more uniform distribution of the combustion air, the wind-box is provided with a plurality of vanes 22 and adjustable dampers 23 for directing the air flow uniformly to higher and lower zones within the wind-box.

Also within the wind-box are three fuel gas manifolds 24, supported by carriages 25 and tracks 26. Extending downstream from the respective manifolds, coaxially with the burner ports, is a plurality of tubes 27, each tipped at its downstream end by a jet or spud 28. Tubes 27 are of substantially greater length than the depth of the burner ports, so that the respective manifolds may be moved forward to a position such that the spuds are at, or near, the downstream end of the burner ports without substantial interference by the manifold with the flow of air into and through the burner ports.

The manifolds 24 are adapted to roll freely backward and forward over the tracks 26, by means of the carriages 25, equipped with flanged rollers 29, without departure from the horizontal or other twisting which might result in the throwing of the spuds out of alignment with the burner ports. Tubes 27 should be sufficiently rigid to avoid sagging, or other dislocation with respect to the axis of the burner ports.

Each of the manifolds is connected to a fuel gas supply line 30, extending to the rear through the vanes and the rear wall of the wind-box through a packing gland 31. Advantageously, the line 30 is calibrated just without the wind-box so that in cooperation with the indicator finger 32 the position of the spuds with respect to the burner ports may be readily determined. The inlet end of tube 30 is connected to a source of fuel gas supply, under pressure, through flexible conduit 33 so as to permit the backward and forward movement of the tube 30.

Each of the manifolds 24 is also provided with a rearwardly extending shaft 34 adapted to the adjusting of the position of the manifolds. Advantageously, the shafts 34 are threaded, as indicated at 35, adapted to engage the female threaded member 36 and to be turned by means of hand wheels 37. With this arrangement, the inner end of the shaft 34 will be connected with a swivel 38, which is, in turn, connected to a bracket 39 fastened to the manifold, as by welding.

The dampers 23 are supported by shafts 40 adapted to be turned to adjust the position of the damper by hand wheels 41, shown in Figure 3.

Access to the interior of the wind-box is readily attained by removing the upstream end of the box which is removably attached to the remainder of the wind-box as by means of flanges 42. The entire wind-box is removably attached to the front plate of the furnace by means of flanges 43, which also support the plate 18.

Referring to the modification of the burner head shown in Figures 7 and 8, in this arrangement the make gas is injected into the furnace through make gas injection tubes 44 extending through the burner block into the furnace chamber in a direction parallel to the burner ports. The make gas inlet tubes 44 are, with advantage, so positioned as to be flanked by the burner ports, as more clearly appears from Figure 8 of the drawings, so that the injected stream of make gas is surrounded by a substantially uniform pattern of blast flames. The tubes 44 should be of refractory material and are, with advantage, so fitted into the burner block as to permit them to be moved forward or backward to adjust their outlet end with respect to the burner block face. The upstream ends of the tubes 44 are connected by tubes 45 with the make gas manifold 46, also positioned within the wind-box and connected by tube 47 with a source of make gas under pressure. Tubes 44 and 45 are, with advantage, connected by a sliding fit to permit the adjustment of the former.

Other parts of the burner head, represented by Figure 7, are substantially identical with those of Figure 2 and are indicated by like reference numerals.

Instead of the vane and damper arrangements shown, other known means for uniformly distributing the air in the wind-box may be employed, for instance, baffles or perforated plates. Though some arrangement of the sort is desirable, particularly in large apparatus having a number of burner ports, it may frequently be omitted, especially in smaller size apparatus.

Likewise, other arrangements may be used for supporting the fuel gas manifolds. It is, however, advantageous, that they be rigidly though adjustably supported so as to maintain the spuds in accurate alignment with the burner ports.

Also, the burner ports need not be flared at their ends, as shown. It is, however, important that they be of substantial depth and advantageous that they be of substantially uniform cross-section over the major portion of their length.

A further highly desirable feature of my burner head is that the ports be so arranged as to leave a substantial area of relatively flat surface on the downstream face of the burner block, usually not less than about 50%, as previously noted. The burner of my invention is designed especially for extremely high burner port velocities and I have found that a much steadier, more uniform

flame condition in normal operation is attained where extensive flat surface is provided at the burner block face between the exits of the burner ports.

In starting a cold furnace, in accordance with the present invention, the fuel gas manifolds are advanced to a point such that the spuds **28** are positioned at, or near, the burner port exits, at least past the mid point of the ports. This is accomplished by turning the hand wheels **37** and the position of the spuds is indicated by the graduated scale on pipe **30**. Air is forced, under pressure, into the wind-box through inlet **20** and fuel gas is passed, under pressure through pipe **30** into the manifolds **24**. The combustion mixture entering the furnace chamber through the burner ports is ignited by usual means, not shown, and is burned with the spuds in the advanced position until the walls of the furnace and the face of the burner block have been highly heated.

After the furnace has been highly heated the manifolds and the spuds attached thereto are retracted, advantageously quite gradually, until the flames issuing from the burner ports have been drawn back to the face of the burner block. Having established the desired blast flame condition, make gas is injected into the chamber through the make gas injection tubes **9** of Figure 1, or tubes **44** of Figure 7 of the drawings, becomes rapidly mixed with the hot, highly turbulent blast flame gases and is decomposed to form the carbon black.

The blast furnace herein described has been found capable of smooth, efficient operation at rates such as to liberate up to at least approximately 3.4 million B. t. u. per hour per cubic foot of combustion space. Even when operating at such high loads, the position of the spuds is not excessively critical but should be adjusted to obtain the most efficient premixing of the air and fuel gas passing through the burner ports. The ratio of fuel gas velocity to the burner port throat velocity of the air is, with advantage, about 6:1, the air velocity advantageously being about 80 to 100 feet per second.

Where operation at such great loads is intended, the respective burner ports should not exceed about 1 to 1⅝ inches in diameter and should be so distributed over the face of the burner block as to leave a substantial area of plane surface of burner block face between and around the exit of the burner ports, advantageously 50% or more of the entire area of the face of the block. This plane surface is, with advantage, of a somewhat rough, porous character. It has been found that the conditions just described materially assist in retaining the flame front against the face of the burner block when operating at full load.

My invention also provides means for adjusting the position of the spuds during normal operation. Usually in normal operation, the spuds will be positioned at, or near, the entrance of the burner port, not more than about halfway through the burner port. Some latitude is permissible in this respect, as previously noted, but in normal operation in the production of carbon black according to the process herein described, the spuds will rarely, if ever, be left at a position downstream from the mid point of the burner ports.

The invention has been particularly described with reference to a burner head adapted for use with a furnace of rectangular cross-section. It will be understood, however, that the invention is readily adaptable to burner heads of circular cross-section and such burner heads are within the contemplation of my invention.

Further, though my improved burner has been described with particular reference to its use in the production of carbon black, it will be understood that its utility is not so restricted.

I claim:

1. A blast burner comprising a burner block of substantial thickness, a wind-box adapted to contain air under super-atmospheric pressure secured to the burner block, a connection adapted to the passing of air under pressure to the wind-box, a plurality of substantially parallel burner ports extending through said block, the outer ends of the respective ports opening into the wind-box, a fuel gas manifold within the wind-box, a plurality of fuel gas spuds each connected with the manifold by a tube of a length substantially greater than the depth of the burner ports, the spuds and connecting tubes being positioned coaxially with the respective burner ports, said fuel gas manifold being so constructed and arranged within the wind-box as to be adapted to be moved therein toward and away from the burner block without altering the alignment of the spuds with the axis of the respective burner ports, and a connection for supplying fuel gas under pressure to the manifold.

2. A blast burner comprising a burner block of substantial thickness, a wind-box adapted to contain air under super-atmospheric pressure secured to the burner block, a connection adapted to the passing of air under pressure to the wind-box, a plurality of substantially parallel burner ports, not exceeding 2 inches in diameter and of a depth not less than 4 diameters, extending through said burner block, the outer ends of the respective ports opening into the wind-box, a fuel gas manifold within the wind-box, a plurality of fuel gas spuds each connected with the manifold by a tube of a length substantially greater than the depth of the burner ports, the spuds and connecting tubes being positioned coaxially with respect to the burner ports, said fuel gas manifold being so constructed and arranged within the wind-box as to be adapted to be moved therein toward and away from the burner block without altering the alignment of the spuds with the axis of the respective burner ports, and a connection for supplying the fuel gas under pressure to the manifold.

3. A blast burner comprising a burner block of substantial thickness, a wind-box adapted to contain air under super-atmospheric pressure secured to the burner block, a connection adapted to the passing of air under pressure to the wind-box, a plurality of substantially parallel burner ports, not exceeding 2 inches in diameter and of a depth not less than 4 diameters, extending through said burner block, the outer ends of the respective ports opening into the wind-box, a fuel gas manifold within the wind-box, a plurality of fuel gas spuds each connected with the manifold by a tube of a length substantially greater than the depth of the burner ports, the spuds and connecting tubes being positioned coaxially with respect to the burner ports, air distributing means within the wind-box adapted to distribute the air uniformly to the respective ports, said fuel gas manifold being so constructed and arranged within the wind-box as to be adapted to be moved therein toward and away from the burner block without altering the alignment of the spuds with the axis of the respective burner ports, and a

connection for supplying the fuel gas under pressure to the manifold.

4. A blast burner comprising a burner block of substantial thickness, a wind-box adapted to contain air under super-atmospheric pressure secured to the burner block, a connection adapted to the passing of air under pressure to the wind-box, a plurality of substantially parallel burner ports of a diameter of 1 to 1⅝ inch and of a depth from 5 to 12 times their diameter extending through said burner block, the outer ends of the respective ports opening into the wind-box, a fuel gas manifold within the wind-box, a plurality of fuel gas spuds each connected with the manifold by a tube of a length substantially greater than the depth of the burner ports, the spuds and connecting tubes being positioned coaxially with respect to the burner ports, said fuel gas manifold being so constructed and arranged within the wind-box as to be adapted to be moved therein toward and away from the burner block without altering the alignment of the spuds with the axis of the respective burner ports, and a connection for supplying the fuel gas under pressure to the manifold.

5. A blast burner comprising a burner block of substantial thickness, a wind-box adapted to contain air under super-atmospheric pressure secured to the burner block, a connection adapted to the passing of air under pressure to the wind-box, a plurality of substantially parallel burner ports, not over 2 inches in diameter and of a depth not less than 4 diameters, extending through said block and uniformly spaced over the surface of said block, the number and size of said burner ports being such that not less than 50% of the area of the burner block face is plane surface, the outer ends of the respective ports opening into the wind-box, a fuel gas manifold within the wind-box, a plurality of fuel gas spuds each connected with the manifold by a tube of a length substantially greater than the depth of the burner ports, the spuds connecting tubes being positioned coaxially with the respective burner ports, said fuel gas manifold being so constructed and arranged within the wind-box as to be adapted to be moved therein toward and away from the burner block without altering the alignment of the spuds with the axis of the respective burner ports, and a connection for supplying fuel gas under pressure to the manifold.

6. A furnace for the production of carbon black which comprises an elongated, unobstructed and unrestricted heat insulated chamber, a burner block of substantial thickness coextensive with the transverse area of the chamber and positioned in one end thereof, a wind-box adapted to contain air under super-atmospheric pressure secured to the burner block, a connection adapted to the passing of air under pressure to the wind-box, a plurality of substantially parallel burner ports, not over 2 inches in diameter and of a depth not less than 4 diameters, extending through said block and uniformly spaced over the surface of said block, the number and size of said burner ports being such that not less than 50% of the area of the burner block face is plane surface, the outer ends of the respective ports opening into the wind-box, a fuel gas manifold within the wind-box, a plurality of fuel gas spuds each connected with the manifold by a tube of a length substantially greater than the depth of the burner ports, the spuds and connecting tubes being positioned coaxially with the respective burner ports, a connection for supplying fuel gas under pressure to the manifold, said fuel gas manifold being so constructed and arranged within the wind-box as to be adapted to be moved therein toward and away from the burner block without altering the alignment of the spuds with the axis of the respective burner ports, and a connection adapted to the injection of a gaseous medium into that end of the chamber adjacent the burner block.

7. In the operation herein described wherein air for combustion is forced under super-atmospheric pressure in separate streams through a plurality of elongated substantially parallel burner ports extending through a burner block of substantial thickness into the combustion zone of a furnace and fuel gas is jetted into each air stream as it passes through the respective ports from a spud coaxially positioned with respect to the burner port, the method of starting a cold furnace which comprises advancing the spuds through the ports to a position beyond the mid point thereof, burning the resultant streams of combustible mixture in the furnace until the walls of the furnace and the face of the burner block have been heated to the ignition temperature of the combustible mixture and thereafter retracting the spuds to a position to the rear of the mid point of the burner ports.

8. In the operation herein described wherein air for combustion is forced under super-atmospheric pressure in separate streams through a plurality of elongated substantially parallel burner ports extending through a burner block of substantial thickness into the combustion zone of a furnace and fuel gas is jetted into each air stream as it passes through the respective ports from a spud coaxially positioned with respect to the burner port, the method of starting a cold furnace which comprises advancing the spuds through the ports to a position near the exit end thereof so that the fuel gas is jetted into the air streams as the latter pass from the ports, burning the resultant streams of combustible mixture in the furnace until the walls of the furnace and the face of the burner block have been heated to the ignition temperature of the combustible mixture, and thereafter retracting the spuds to a position near the inlet end of the burner ports.

9. In the operation herein described wherein air for combustion is forced under super-atmospheric pressure in separate streams through a plurality of elongated substantially parallel burner ports extending through a burner block of substantial thickness into the combustion zone of a furnace and fuel gas is jetted into each air stream as it passes through the respective ports from a spud coaxially positioned with respect to the burner port, the method of starting a cold furnace which comprises advancing the spuds through the ports to a position near the exit and thereof so that the fuel gas is jetted into the air streams as the latter pass from the ports, burning the resultant streams of combustible mixture in the furnace until the walls of the furnace and the face of the burner block have been heated to the ignition temperature of the combustible mixture, the flame front being a substantial distance downstream from the face of the burner block, then gradually retracting the spuds until the flame front has been drawn back to the face of the burner block.

10. A furnace for the production of carbon black which comprises an elongated, unobstructed

and unrestricted heat insulated chamber, a burner block of substantial thickness coextensive with the transverse area of the chamber and positioned in one end thereof, a wind-box adapted to contain air under super-atmospheric pressure secured to the burner block, a connection adapted to the passing of air under pressure to the wind-box, a plurality of substantially parallel burner ports, not over 2 inches in diameter and of a depth not less than 4 diameters, extending through said block and uniformly spaced over the surface of said block, the number and size of said burner ports being such that not less than 50% of the area of the burner block face is plane surface, the outer ends of the respective ports opening into the wind-box, a fuel gas manifold within the wind-box, a plurality of fuel gas spuds each connected with the manifold by a tube of a length substantially greater than the depth of the burner ports, the spuds and connecting tubes being positioned coaxially with the respective burner ports, a connection for supplying fuel gas under pressure to the manifold, said fuel gas manifold being so constructed and arranged within the wind-box as to be adapted to be moved therein toward and away from the burner block without altering the alignment of the spuds with the axis of the respective burner ports, and a connection adapted to the injection of a gaseous medium into that end of the chamber adjacent the burner block, said connection extending through the burner block substantially parallel to the axis of the burner ports and so positioned as to be flanked by the burner ports.

11. A furnace for the production of carbon black which comprises an elongated, unobstructed and unrestricted heat insulated chamber, a burner block of substantial thickness coextensive with the transverse area of the chamber and positioned in one end thereof, a wind-box adapted to contain air under super-atmospheric pressure

secured to the burner block, a connection adapted to the passing of air under pressure to the wind-box, a plurality of substantially parallel burner ports, not over 2 inches in diameter and of a depth not less than 4 diameters, extending through said block and uniformly spaced over the surface of said block, the number and size of said burner ports being such that not less than 50% of the area of the burner block face is plane surface, the outer ends of the respective ports opening into the wind-box, a fuel gas manifold within the wind-box, a plurality of fuel gas spuds each connected with the manifold by a tube of a length substantially greater than the depth of the burner ports, the spuds and connecting tubes being positioned coaxially with the respective burner ports, a connection for supplying fuel gas under pressure to the manifold, said fuel gas manifold being so constructed and arranged within the wind-box as to be adapted to be moved therein toward and away from the burner block without altering the alignment of the spuds with the axis of the respective burner ports, and a tubular connection extending inwardly through the chamber wall and adapted to the injection of a gaseous medium therein.

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