A portable cross-fire burner flameworking device includes a table, two or more gas hookups, two or more regulator and flow meter pairs respectively connected so as to be able to receive gas from the gas hookups, two or more control valves respectively connected so as to be able to receive gas from the regulator and flow meter pairs, and two burners having burner heads each connected so as to be able to receive gas from the two or more control valves mounted on the table. Each burner head has a burner face, and the burner faces are oriented towards each other at a distance. The two or more gas hookups are connected to the table so as to be portable therewith, the two or more regulator and flow meter pairs are connected to the table so as to be portable therewith, the two or more control valves are connected to the table so as to be portable therewith, and the two burner heads are likewise connected to the table so as to be portable together therewith. At least one of the two burner heads is connected to the table via a moveable mount allowing the distance between the burner faces to be adjusted.
SELF-CONTAINED FLAMMWORKING BENCH

[0001] This application claims the benefit of priority under 35 U.S.C. §119(e) of U.S. Provisional Application Ser. No. 60/932,671 filed on May 31, 2007, the content of which is relied upon and incorporated herein by reference in its entirety.

BACKGROUND

[0002] The present invention relates generally to opposing flame flameworking benches useful for glass forming, and particularly to opposing flame flameworking benches for laboratory use.

[0003] Flameworking benches find application in laboratory testing and in manufacturing-based testing of glass materials, particularly because standard practices for certain tests or analyses require that the material to be tested be in the form of a fiber or other specific shape within relatively tight dimensional tolerances. The test samples are typically prepared by a skilled worker drawing the required fiber shape, or forming any other required test sample shape, using a flameworking bench. The starting form of the glass may typically be a rod or tube or other form generated by the glass forming or glass making process under study, or produced from a laboratory melt.

[0004] An opposing flame flameworking bench, also known as a cross-burner bench, is often used for flameworking glass materials such as glass rods both for artistic and laboratory purposes. The typical opposing flame flameworking bench has two burners connected to and mounted above a typically horizontal bench surface, with the burners facing each other horizontally across a gap. When the burners are in operation, the flames from the burners approach the center of the gap from opposite sides. A glass article to be worked is heated and softened by an operator placing the article within the gap, allowing the article to be heated by the flames. The presence of two flames coming from opposite directions generally allows for quicker, more uniform and more controlled heating relative to a single flame.

[0005] As an example of a research laboratory or manufacturing-lab test, Blister Gas Analysis (“BGA”) is a method where a glass sample that has a blister seed in the glass is tested for the gas composition to help determine the cause or problem in the melting tank. The sample is pulled into a thin fiber or capillary to fit into the sample holder. The sample size generally has to be 1 mm x 40 mm with smooth or beaded ends, with the center of the seed positioned about 12 mm from the top end of the capillary.

[0006] As higher performance glasses are introduced into mass production environments, manufacturing-based labs will need to prepare testing samples of glass materials having a wider range of properties than in the past. In particular, glasses with annealing points of up to 800° C. or greater, and with softening points of up to 1050° C. or greater, would desirably be handled on the same bench as glasses with annealing points as low as 400° C. or less, and softening points of 450° C. or less. For adequate manufacturing quality control across multiple sites, it is also desirable that the bench be standardized in such a way as to guarantee consistent performance across multiple installations in multiple locations.

SUMMARY

[0007] A portable cross-fire burner flameworking device according to an aspect of the present invention includes a table, two or more gas hookups, two or more regulator and flow meter pairs respectively connected so as to be able to receive gas from the gas hookups, two or more control valves respectively connected so as to be able to receive gas from the regulator and flow meter pairs, and two burners having burner heads each connected so as to be able to receive gas from the two or more control valves mounted on the table. Each burner head has a burner face, and the burner faces are oriented towards each other at a distance. The two or more gas hookups are connected to the table so as to be portable therewith, the two or more regulator and flow meter pairs are connected to the table so as to be portable therewith, and the two burner heads are likewise connected to the table so as to be portable therewith. Further, at least one of the two burner heads is connected to the table via a moveable mount allowing the distance between the burner faces to be adjusted.

[0008] Additional characteristics and features of the present invention will be apparent from the description and claims below, including the attached figures, of which:

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] FIG. 1 is a diagrammatic plan view, approximately but not precisely to scale, of a presently preferred embodiment of a flameworking bench 10 of the present invention;

[0010] FIG. 2 is a diagrammatic elevational view of the bench 10 of FIG. 1;

[0011] FIG. 3 is a perspective view of burners 24 and associated structures, showing, for convenience in depiction of details, only a portion of the table 12; and

[0012] FIG. 4 shows a closer view of the burner 24 and burner face 58 visible in FIG. 3.

DESCRIPTION

[0013] Reference will now be made in detail to the presently preferred embodiments of the invention, instances of which are illustrated in the accompanying drawings. Whenever possible, the same reference numerals will be used throughout the drawings to refer to the same or like parts.

[0014] FIG. 1 is a diagrammatic plan view, approximately but not precisely to scale, of a presently preferred embodiment of a flameworking device commonly referred to as a “bench” 10 of the present invention. FIG. 2 is a diagrammatic elevational view of the bench 10 of FIG. 1. FIG. 3 is a perspective view of burners 24 and associated structures, showing, for convenience in depiction of details, only a portion of the table 12. FIG. 4 shows a closer view of the burner 24 and burner face 58 visible in FIG. 3.

[0015] The bench 10 includes a table 12 preferably comprised of stainless steel or other high-temperature-resistant material with relatively low specific heat. This provides a durable surface that is quickly cooled after use. Mounting holes or other standard mounting fixtures 14 are provided to allow the bench 10 to be easily mounted on any table or frame. Attached to the top surface of the table 12 near the rear of the
table 12 (toward the top in the orientation of the figure) is a regulator panel 18, including three gas input fittings 16 such as NPT fittings for oxygen, air, and fuel gas such as natural gas or propane. The regulator panel 18 also includes, for each input gas, a regulator and instrument array 20.

As may be seen in FIG. 2, each regulator and instrument array includes, in order along the gas flow path, an adjustable regulator 48, a pressure indicator such as a pressure gauge 50, and a flow meter such as an in-line tubular flow meter 52. Next in the flow path of the gases, needle valves 22 are provided on the table 12 to control the flow and on/off status of the gases. Gas hoses 21 carrying the gases from the fittings 16 through the regulator and instrument arrays 20 to the needle valves 22 and then to the burner heads 24 (only one of three hose sets is shown in this last stage, for clarity of representation) are preferably enclosed and/or sealed within the table 12 or at least integrated with it in such fashion as to constitute a single integrated product with limited user-serviceable parts. This helps ensure that each table performs identically or nearly identically over its useful life before replacement or refurbishing. The resulting flame bench 10 is portable, allowing for easy installation and set-up by simply attaching the table to an adequate support (which may also be a portable device), and connecting gas supplies to the fittings 16.

The burner heads 24 face each other across a distance or gap 26. Each burner head 24 is supported on a pair of pipes 40, 42 (only one pipe of one pair is visible in FIG. 2), which pipes 40, 42 also carry the fuel gas and, separately, the combined oxygen and air to the burner head 24. The pipes 40, 42 are in turn supported in a base 44 mounted on the table 12. At least one of the bases 44 is preferably mounted in an adjustable manner via a moveable mount, such as in a groove 28 with a screw 54 for fixing the base 44 at any desired point along the groove 28. This provides the capability to adjust the dimension of the gap 26.

A tipping torch 32, a fuel and oxygen torch for forming ends or tips on fibers and other test structures formed at the bench, is desirably also mounted on the surface of the table 12, near the front burner 24 as shown in FIG. 1. As an alternative embodiment, the tipping torch 32 may be mounted to the side and in back of the rear burner 24, as shown by the reference character 34, or both mounting positions may be provided on the table 12, with the position of the torch selectable by the user. The tipping torch 32 includes a pre-mixed flame tip 46 and a coupled base 48, the coupled base allowing replacement of the torch 32. Needle valves 30 at the front of the bench control gas flow to the tipping torch 32. Needle valves 30 and needle valves 22 are preferably protected by guards not shown in FIG. 1, guard 31 and guard 23 respectively as shown in FIG. 2, so that the valves are not accidentally turned.

For convenience in working at the bench 10, a preferably circular hole or depression 35 is desirably provided in the surface of the table 12. The hole 35 is preferably filled with a wooden cylinder or disk 36 having at least one hole 38 formed therein. Rods from which glass structures are being drawn or otherwise worked or formed may be held by placing them in the hole 38.

Some details of a preferred head 24 are shown in FIG. 4. The burner face 58 is that of a surface mixing burner including, in this example, nine (9) gas ports or nozzles 60. Each gas port 60 includes a central fuel gas pipe 62 through which fuel gas is to be conducted out of central passage 64. Surrounding the fuel gas pipe 62 is a concentric ring gas passage 66 formed between the face 58 of the burner 24 and the fuel gas pipe 62. The oxygen and air mixture determined by the regulator and needle valve settings is conducted out of the concentric ring gas passage 66. Although nine nozzles 60 are included on each burner head 24 in the burner head shown, other numbers of nozzles and configurations are of course possible, but should be selected with the end in mind that the center of the flame should generally be the hottest portion, or at least should not be a cool spot within the flame. As with the table, 12, the burner head 24 is preferably formed of stainless steel or other high-temperature-resistant material with relatively low specific heat.

The opposing flame (cross-burner) bench 10 of the present invention has several advantages. The use of surface mixing burners 24 eliminates the possibility of flash back, allowing for safer use of higher temperatures. The surface mix burners 24 also allow saving room and cost by eliminating the use of mixing chambers and valves.

The surface mixture burners also provide another added feature increased distance without increased flame. Since mixing takes place beginning at and continuing even somewhat away from the burner face 58, and not in up-line from the burner face in a mixture chamber, the hottest part of the flame extends further from the burner face 58 with a surface mixing burner than with a pre-mix burner. As a result, the distance 26 between the burner faces 58 can be increased relative to premix burners, while still achieving the correct temperature range for glass sample preparation. This increased distance 26 gives the operator a larger working area. This increased distance can reduce instances of the operator accidentally bumping a work piece with molten glass against the surface 58 of the front burner 24. Such bumping can cause clogging of the burner and the hazards of uneven or unequal flame pressures.

The adjustable distance 26 gives flexibility to the user to increase the materials range of the bench. The currently preferred adjustable distance 26 or range of adjustment is about 5 centimeters. By decreasing the distance 26 and lowering the flames, low viscosity glasses can be worked. By increasing the distance 26 the user has room to turn up the flames, allowing higher viscosity glasses to be worked.

1. A portable cross-fire burner flameworking device, the device comprising:

   a table;
   two or more gas hookups;
   two or more regulator and flow meter pairs respectively connected so as to be able to receive gas from the gas hookups;
   two or more control valves respectively connected so as to be able to receive gas from the regulator and flow meter pairs; and
   two burners having burner heads each connected so as to be able to receive gas from the two or more control valves, each burner head having a burner face, the burner faces oriented towards each other at a distance; wherein the two or more gas hookups are connected to the table so as to be portable therewith, the two or more regulator and flow meter pairs are connected to the table so as to be portable therewith, the two or more control valves are connected to the table so as to be portable therewith, the two burner heads are connected to the table so as to be portable therewith, and at least one of the two burner
heads is connected to the table via a moveable mount allowing the distance between the burner faces to be adjusted.

2. The device as recited in claim 1 further comprising gas hoses respectively connecting the two or more regulator and flow meter pairs to the two or more control valves, the gas hoses connected to the table so as to be portable therewith.

3. The device as recited in claim 2 wherein the gas hoses are enclosed within the table.

4. The device as recited in claim 1, wherein the burner heads are surface-mixing burner heads.

5. The device as recited in claim 3 wherein the burner heads are comprised of stainless steel.

6. The device as recited in claim 4 wherein the burner heads comprise concentric nozzles.

7. The device as recited in claim 1, said device having three or more gas hookups, three or more regulator and flow meter pairs respectively connected so as to be able to receive gas from the gas hookups and three or more control valves respectively connected so as to be able to receive gas from the regulator and flow meter pairs.

8. The device as recited in claim 1, the device further comprising a torch connected to the table via a coupler so as to be replaceable.

9. The device as recited in claim 8 wherein the torch is a pre-mix torch.

10. The device as recited in claim 1 wherein the table further comprises at least one depression arranged and positioned so as to be useful for holding pieces to be worked at the device.

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