Jan. 20, 1942. J. JARES 2,270,442

COLORED FLAME PRODUCTION AND CONTROL

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Fig. 1.

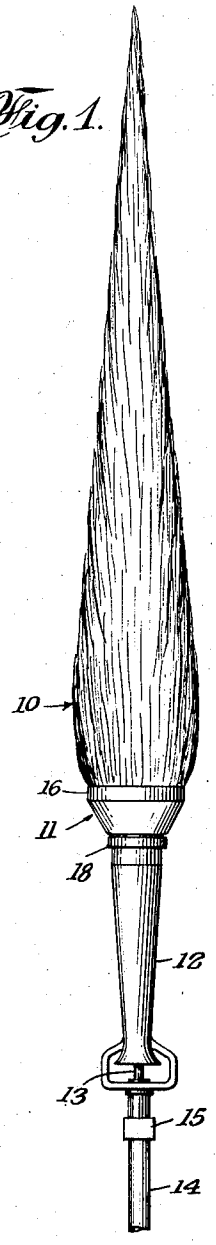

Fig. 2.

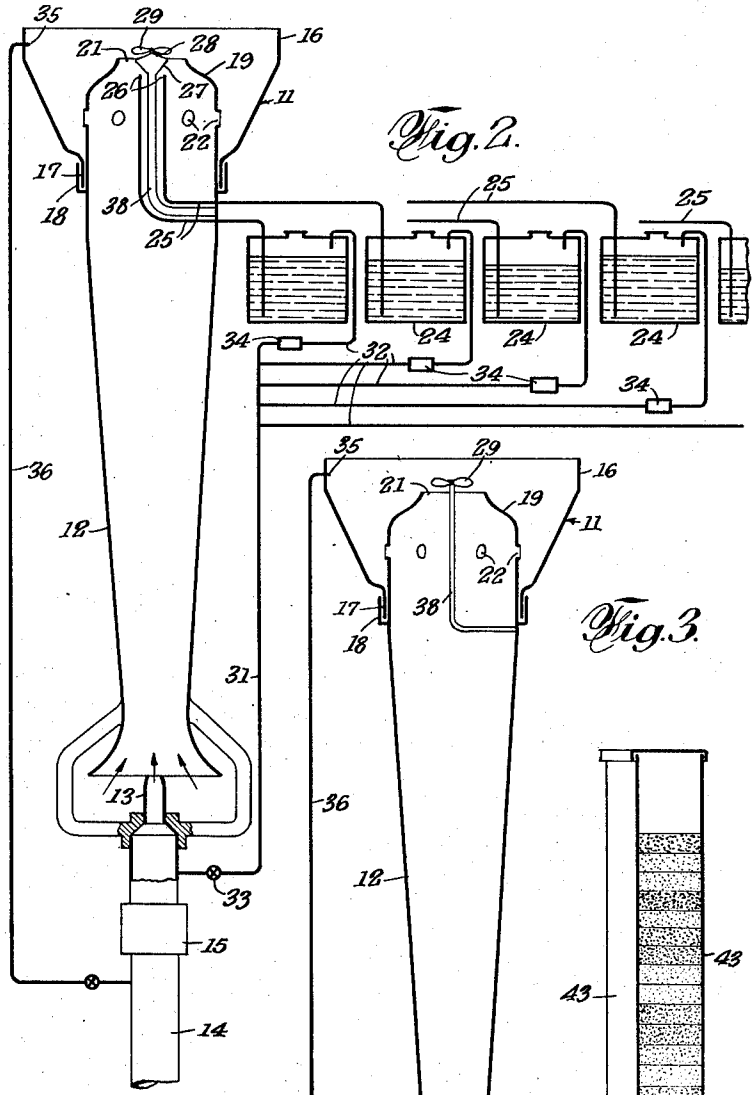

Fig. 3.

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Fig. 4.

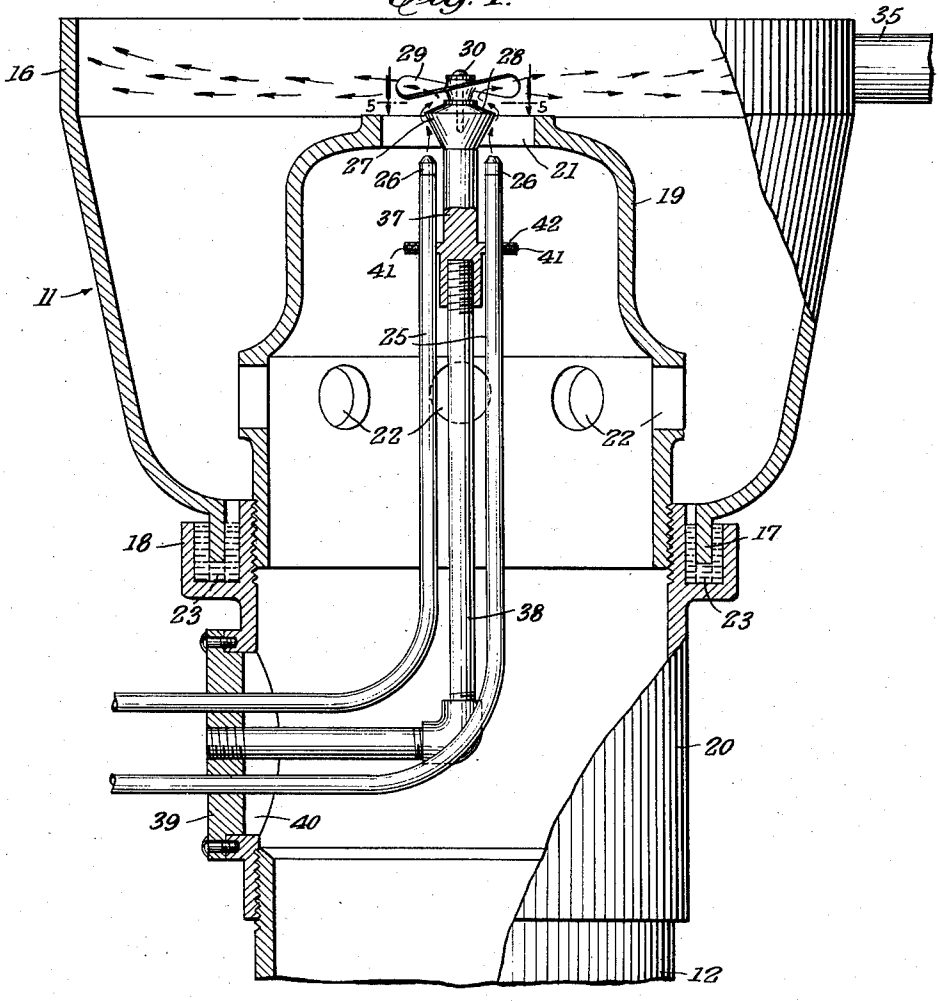
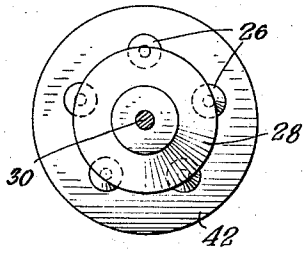


Fig. 5.



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COLORED FLAME PRODUCTION AND CONTROL

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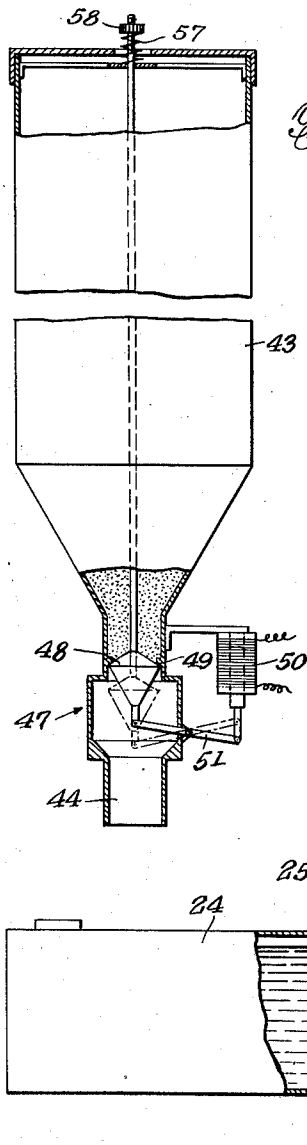

Fig. 6.

Fig. 7.

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UNITED STATES PATENT OFFICE

2,270,442

COLORED FLAME PRODUCTION AND CONTROL

Joseph Jares, Brooklyn, N. Y.

Application February 27, 1939, Serial No. 258,817

14 Claims. (Cl. 67—1)

The invention here disclosed relates to the creation and control of colored flames, for display or other purposes.

Objects of the invention are to create unusual and spectacular flame effects, particularly for artistic, theatrical and outdoor display purposes, to provide such flame effects in different colors, changeable and controllable at will; to control such flames in matters of size, increasing and decreasing height, visibility and invisibility, speed or rate of change, etc.; and to provide for such purposes simple, practical, safe and efficient mechanism for accomplishing these results.

Other desirable objects and the novel features of construction, combinations and relations of parts by which the purposes of the invention are attained will appear or are set forth in the course of the following specification:

The drawings accompanying and forming part of this specification illustrate certain definite practical embodiments of the invention. The structure however, may be modified and changed as regards the present disclosure, all within the scope of the invention as will be apparent from the description and the broad scope of the claims that follow:

Fig. 1 is a view in elevation of one of the colored flame burner assemblies illustrating in particular the general shape and character of flame produced, with a broad full base, tapering up to a considerable height.

Fig. 2 is a diagrammatic illustration of the burner, showing the liquid color feeding connections.

Fig. 3 is a similar view, illustrating a modified form utilizing color creating materials in solid form.

Fig. 4 is an enlarged sectional detail view of the burner head, equipped for liquid color feeding.

Fig. 5 is a further enlarged horizontal sectional view as on line 5—5 of Fig. 4, showing in particular the liquid color distributing head and color nozzles delivering to the same.

Fig. 6 is a broken detail view of a form of control valve for the dry color feed mechanism.

Fig. 7 is a part sectional and partly diagrammatic illustration of a simplified form of the invention.

In Fig. 1, a type of flame desired for exhibition purposes is illustrated, it having a wide full base at 10, a short distance above the point of origin and tapering from there substantially continuously and without break to a considerable height. In this particular illustration, the flame may be considered as having a height of approximately six feet and as having a maximum base diameter of about twelve inches at a height of about 9 inches above the lip of the flame spreader 11.

Commercial illuminating gas under pressure has been found to be the fuel best suited to the creation and control of colored flames of the type under consideration. The burner structure therefore embodies in the illustration a Venturi air-gas mixer 12, into the open air mixing end of which the nozzle 13, of a high pressure gas line 14 discharges. In this gas line there is provided a remotely controlled motor operated valve 15, which may be of standard construction and details of which are not shown.

The flame collecting and spreading head 11, as indicated in Figs. 2, 3 and as shown in detail in Fig. 4, is in the form of an inverted, truncated conical bowl having a substantially cylindrical deflector and confining wall 16, at the upper, larger open end of the same and a confining flange 17, at the lower smaller open end, dipping into and resting on the bottom of a trough 18, to constitute a water seal.

The burner tip is shown as a hollow head 19, screwed into the upper end of the water seal collar 20, having a central vertical port 21, in the upper end of the same and a multiplicity of horizontal ports 22, discharging horizontally into the upwardly divergent walls of the spreader bowl.

In the outdoor service for which the burner is intended, the bowl will collect sufficient moisture to serve as a seal in the trough 17, and the passages 23, in the lower edge of the bowl seated in the trough will permit escape and overflow of excess water from rain or the like.

When the color material is in liquid form, the construction indicated in Fig. 2 and shown more fully in Fig. 4, is employed. The flame coloring liquid is confined in one or a number of tanks, such as shown at 24, and each one of these is connected by a pipe line 25, with a nozzle 26, directed upwardly against the lower end of an inverted frusto conical spreader 27, which has a convergent frusto-conical upper surface 28, directly beneath a propeller 29, pivoted to rotate on an axis 30, over the central burner port 21, and in general horizontal alignment with the confining rim 16, of the flame collector or defining bowl. Static gas pressure is utilized for forcing coloring liquid up through the delivery lines 25, by extending a pressure line 31, from the main gas pipe up into the top of the tanks 25, as through branches 32, this pressure line being

shown as having a main shut-off valve 33, and the branches as having remotely controlled magnet valves 34—details of the latter not being shown, as they may be of known standard construction.

The color liquid delivery lines 25, are shown as extended downward close to the bottoms of the tanks 24, so as to be capable of delivering all or practically all the contents of each tank.

Usually the mixture is adjusted to produce a Bunsen type flame, practically colorless and more or less invisible. Ignition of the normal or primary flame is effected in the illustration by a pilot indicated at 35, in the rim of the flame collector and which may be of the remote control electrically ignited type supplied with gas through a line 36, from the main gas supply line 14.

For the color producing liquids, it is preferred to use the salts of certain metals, such as copper, strontium, lithium, and sodium, dissolved in a combustible solvent such as alcohol and preferably one of those of the lower molecular weights such as methyl, ethyl, propyl or iso-propyl. These alcohols are slow burning, so their injection in the gas flame will produce a desired increase in flame size and they burn with non-luminous effect, so as not to interfere with or detract from the color furnished by the metallic salts. Further, these metallic salts are sufficiently soluble in such alcohols so that a single common solvent can be used, with different metallic salts for production of a considerable variety of colors. Use of such a common solvent is particularly desirable when making up mixtures of metallic salt solutions for production of the pastel colors.

The invention contemplates further the production of colored flames under the injection method indicated with alcoholic solutions of certain commercially pure acetates, nitrates, oleates and perchlorates of the various colored spectrum producing metals. The selection however is not limited to the acetates, nitrates, oleates and perchlorates, but these are preferred because of their ready availability at reasonable costs. A general characterization of this phase of the invention might therefore be simply the use of metallic salt solutions in combustible organic solvents.

The main or primary flame is under immediate control of the motor actuated valve 15, which normally is under remote control for starting, stopping or governing the size of such flame. The flow of the air gas mixture through the central burner port 21, keeps the distributing propeller 29, in rotation, so that when any one or any number of the valves 34 are opened, as from a remote control point, a jet or jets of fluid from a nozzle or nozzles 26, Fig. 4, will be carried by the air-gas flow up over and around the double conical spreader 27, 28, inward to the hub of the propeller 29, and there be picked up by the blades of the propeller and thrown outward into and across the base of the flame in more or less of a liquid spray, toward and against the confining and dispersion rim portion 16. In this manner, the color creating material is fully distributed and incorporated in the flame, making it possible to create and to change the colors practically instantly. One or any number or any combinations of colors may be generated. The injection of the coloring medium has a desirable flame stretching effect, increasing in accordance with amounts of injected coloring material.

In Fig. 4, the conical spreader, propeller and color conducting nozzles are all shown carried by a single supporting stud 37, on the upper end of an angularly projecting supporting arm 38, secured to a cap 39, closing an opening 40, in one side of the water seal collar 20. The spreader and propeller are shown of a size to pass freely through the central burner port 21, so that removal of the supporting cap 39, permits the nozzle and liquid distributing structure to be readily removed and replaced through opening 40. Set screws 41, or the like may be provided for securing the color nozzle or nozzles 26, in desired adjustment in the flange 42, of the supporting stud 37, so that the jets of color liquid will strike the under surface of the spreader in proper relation to adhere, conform to and spread up over such surfaces and then converge inwardly more or less to the hub portion of the spray distributing propeller.

The novel construction of the burner head with central vertical port and horizontal side ports, in conjunction with the surrounding bowl provides a quiet burning large volume flame of desirable shape and the distribution of coloring matter as indicated, creates a substantially uniform flame color or changing or multiple color effects in accordance with the control exercised. The air-gas flow is utilized at the central burner port to confine and to carry the coloring liquid up over the spreader to the distributor and the latter is rotated by this same flow. Similarly, pressure of the gas is utilized to feed the liquid to the delivery nozzle or nozzles. Thus necessary operations are accomplished without need of auxiliary motors.

Various combination flame colors of uniform tint may be produced by simultaneous introduction of two or more metallic salt solutions of similar chemical characteristics. Thus strontium perchlorate and sodium perchlorate in suitable concentrations will produce orange colored flame, whereas when used alone they produce a characteristic strontium red and sodium yellow respectively.

To produce more than one lasting distinct color effect at a time, it is found preferable to use metallic salt solutions of different chemical characteristics, such as strontium perchlorate with copper nitrate, which combine to generate a flame having a distinct red inner cone and a green mantle. This multi-color phenomena is believed to be due to different rates of combustion of the respective metallic perchlorates, nitrates, acetates, oleates and other alcohol soluble salts.

Spectacular flame colors may thus be created by careful selection of metallic constituents, particularly those of contrasting color effects, such as strontium red, barium green, and sodium yellow and in addition choosing such metals in combination with different acids, such as acetic, perchloric, nitric and oleic to secure different rates of combustion and heats of dissociation.

In the solid color feed form of the invention illustrated in Fig. 3, the color producing chemicals in solid form are supplied from a hopper or hoppers 43, through a spout or spouts 44, into a channel 45, in a rotating turntable 46, which carries the material into the range of suction at the throat of the Bunsen burner form of air injector. In this manner, the solid color producing particles are entrained by the air-gas mixer and carried by the latter to the combustion zone

of the burner head. In this design, the conical spreader is not required and only the distributing propeller is used for thoroughly mixing the coloring materials in the flame structure.

The feed of the solid material is controlled in the illustration by a valve 47, shown in Fig. 6, as consisting of a valve element 48, cooperable with a valve seat 49, in the discharge spout of the hopper, said valve being remotely controlled by means of a solenoid magnet 50, connected with the valve element through suitable linkage 51. This control valve is indicated as normally held closed by a spring 57, and as having its opening movement regulatable by an adjustable nut 58.

For producing a succession of colors, the materials required for different colors may be arranged in layers in the hopper as particularly indicated in Fig. 3. With the use of hoppers of different color material however, the control valves may be utilized to generate different selected colors at will.

As the gas flame supplies the necessary heat for volatilization of the metallic salts, it is not necessary or desirable to include with the solid color materials any fuel elements, oxidizing agents or stabilizers, such as required for color production with the solids used in firework displays. The invention contemplates use of any free flowing, preferably crystalline metallic salt or various mixtures of such salts.

For reasons of economy, it is usually desirable to dilute these metallic salts with some free flowing combustible material, which in addition to reducing total cost, gives increased bulk, aiding in better distribution. By way of example, the pure metallic salts may be diluted with small wood chips, spent coffee grounds, shredded corn or other dust free light weight combustible substance.

With dry sodium chloride, a bright yellow flame can be created. Yellowish green colors can be obtained with dry granulated copper sulphate. Deep red is obtainable with strontium carbonate applied as a coating to balsa wood chips. Shredded corn or coffee grounds treated with lithium fluoride will produce bright crimson.

In the simpler form of the invention shown in Fig. 7, the burner involves one or more high velocity gas jets proportioned to the available gas pressure to entrain sufficient primary air without use of primary air injector and in such manner that each jet burns with a slightly luminous flame. Such a high velocity burner is indicated at 52. Pressure of the gas for feeding the coloring liquid is utilized as in Fig. 2, by extending a pressure line 31, from the gas supply piping into the top of the liquid containing tank. In addition to the control valve 53, in the pressure line 31, there is provided in this illustration a pressure relief line 54, terminating at the burner at 55, and controlled by a pressure release valve 56. Both valves 53 and 56, may be of the normally closed solenoid operated type and usually they are interconnected so that only one or the other can be opened at a time.

When valve 53 is opened, pressure of the gas will be made effective to force the color liquid up through piping 25, and through nozzle 26, which discharges a fine stream of liquid upwardly at an incline into the jet from burner nozzle 52, which atomizes and disperses the liquid within the gas flame. Heat of the burning gas flame vaporizes the atomized liquid, assuring perfect combustion of both fuels.

The sudden addition of liquid fuel to the comparatively short faintly visible gas flame produces a new combustion flame of greater extended length and full visibility. When valve 53, is closed and valve 56, opened, as by reversal of interlocking switch contacts, gas pressure on the surface of the liquid in tank 24, is instantly released, causing immediate stoppage of liquid color flow. This effects sudden drop of the flame and change from the extended and highly visible colored flame back to the semi-luminous short gas flame. Thus by simple manipulation of a reversible double acting switch or like control for valves 53 and 56, suddenly rising and falling colored flame effects can be created.

To create slowly rising and falling flames, the pressure valve 53, may be kept open and then with valve 56, closed, the motor driven gas valve 15, be rocked back and forth by manipulation of the switch mechanism controlling the same. As the pressure line to the liquid tank is open at such time, changes in outlet area of the valve 15, effect proportional pressure changes on the liquid in the tank, with the consequent resulting changes in the feed of both fuels producing the effect of a more or less slowly rising and falling flame.

More than one color jet may be used with the high pressure type of burner shown in Fig. 7, and if desired, the sudden pressure release form of control at 54, 55, 56, may be applied and used with the multi-jet form of burner shown particularly in Fig. 2.

By proper combinations of burners and controls a great variety of color effects can be produced.

Further, the color effects may be substantially modified or completely changed by the addition to the alcohol solvents of small quantities of chlorine containing substances, such as chloroform or other suitable chlorine derivatives. The alcohol soluble copper salts will produce green colored flame. A small percentage of chloroform added to the alcohol solution of copper salts changes such flame completely to a deep blue, free of any green tint.

Similarly strontium red in alcoholic solution may be changed to deep purple by addition of chloroform to the alcoholic solution.

This aspect of the invention therefore contemplates and includes in general the introduction or addition of chlorine derivatives to create new color effects not obtainable with the simple alcoholic solutions.

What is claimed is:

1. The method of creating colored flame effects, which comprises utilizing gas under pressure as a flame source, applying the pressure of said gas for feeding flame coloring ingredients to said flame and controlling the application of such pressure to the feeding of said ingredients.

2. The method of creating changing colored flame effects, which comprises mixing air and gas under pressure to provide a semi-luminous flame and selectively applying the pressure of the gas to force different color forming ingredients to the flaming mixture.

3. The method of creating colored flame effects, which comprises providing a flame of gas under pressure, applying the pressure of said gas to supply color forming ingredients to said flame and releasing the pressure of said gas on the color forming ingredients to instantly discontinue the supplying of such ingredient to the flame.

4. Apparatus for colored flame producing, comprising a gas-air mixer having a central and side burner ports, a flame collector about said ports, a color forming ingredient distributor at said central port and means for supplying color forming ingredients to said distributor.

5. In colored flame production, a burner head having a central and side ports, a flame collector about said ports, a color forming ingredient distributor at said central port and means for introducing color forming ingredient to said distributor.

6. In combination, a burner head having a substantially vertical port and substantially horizontal ports below the same, a bowl of inverted frusto-conical formation about said ports, means for delivering color forming ingredient to said central port and a rotary distributor at said central port, substantially in line with a surrounding wall portion of said bowl.

7. In combination, a burner head having an upright port and side ports below the same, a flame collector about said ported portions of said burner head, said collector having an annular confining wall above said upright port, a fluid pressure operated propeller at said upright port and in fluid dispersing relation to said surrounding wall and means for delivering liquid flame coloring compound to said propeller.

8. In combination, a burner head having an upright port and side ports below the same, a flame collector about said ported portions of said burner head, said collector having an annular confining wall about said upright port, a fluid pressure operated propeller at said upright port and in fluid dispersing relation to said surrounding wall, means for delivering liquid flame coloring compound to said propeller, including a nozzle or nozzles and a spreader in the range of the same beneath said propeller.

9. In colored flame apparatus, a burner head, a flame collecting bowl about the same, said bowl being open at the top and an overflow water seal between the lower rim of said bowl and said burner head.

10. In outdoor flame apparatus, an upright burner head, a flame collector bowl about the same, said bowl being open at the top and an overflowing water seal coupling between the burner head and the base of said bowl.

11. An outdoor colored flame projector, comprising an upright burner head, an open top flame collector bowl about the same, a double-faced conical distributor in said burner head, a distributing propeller above said distributor and a nozzle or nozzles for delivering flame coloring liquid to the underside of said double-faced distributor.

12. In apparatus of the character disclosed, the combination of a gas burner, a gas supply line connected therewith, a flame coloring material reservoir, material feeding connections extending from said reservoir to said burner and pressure supplying connections extending from said gas supply line to said reservoir.

13. In apparatus of the character disclosed, the combination of a gas burner, a gas supply line connected therewith, a flame coloring material reservoir, material feeding connections extending from said reservoir to said burner, pressure supplying connections extending from said gas supply line to said reservoir, a pressure relief valve connected with said reservoir and a pressure control valve in said pressure supply connection.

14. In apparatus of the character disclosed, the combination of a gas burner, a gas supply line connected therewith, a flame coloring material reservoir, material feeding connections extending from said reservoir to said burner, pressure supplying connections extending from said gas supply line to said reservoir, a pressure relief valve connected with said reservoir, a pressure control valve in said pressure supply connection and said valves being interlocked to prevent both standing open at the same time.

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