Dec. 26, 1967 G. W. THOMPSON 3,360,029

FLAME TREATING BURNER DEVICE

Filed Sept. 29, 1965

FIG. 1

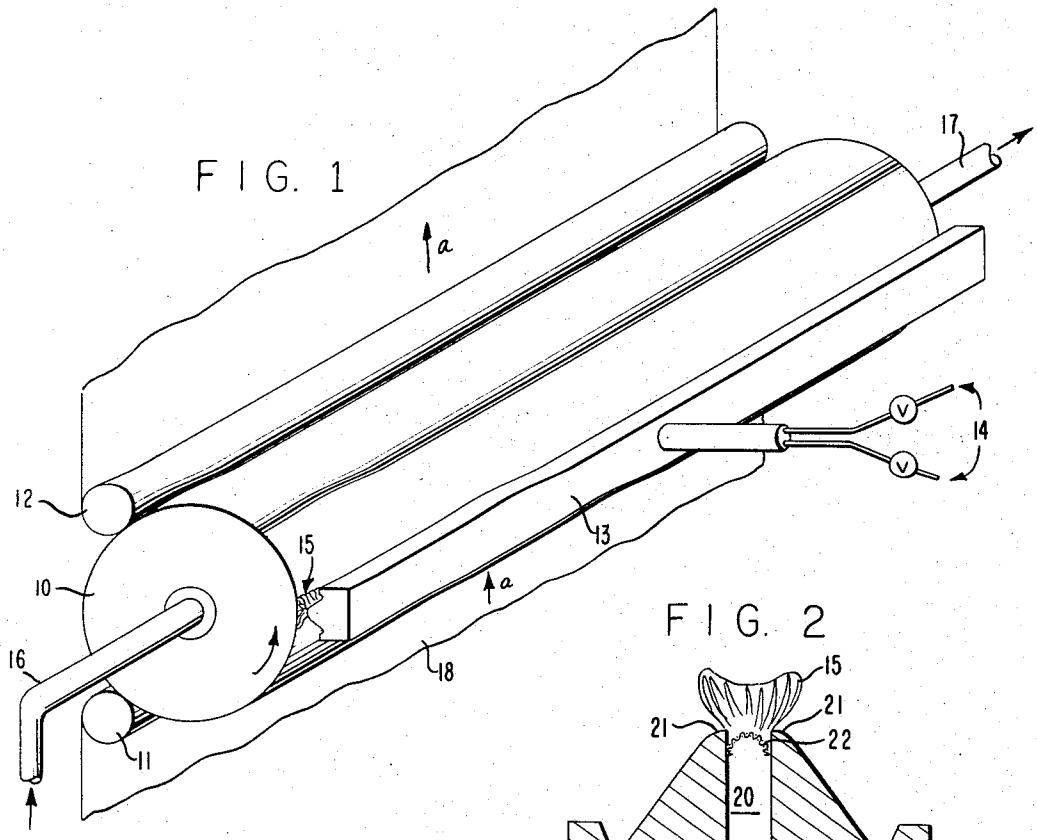


FIG. 2

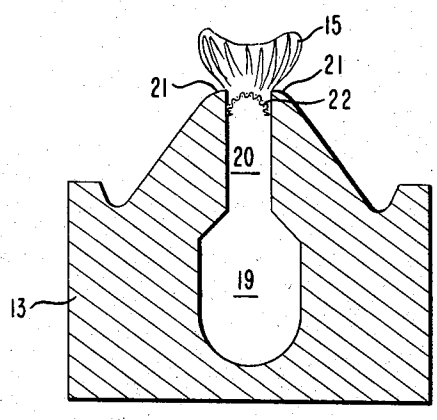
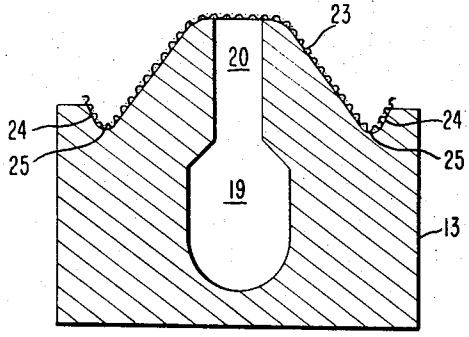


FIG. 3



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FLAME TREATING BURNER DEVICE

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2 Claims. (Cl. 158—116)

The present invention relates to a burner device for burning combustible gaseous fuel and, more particularly, is directed to an improved burner device employed in apparatus for flame treating organic thermoplastic polymeric material.

Flame treatment of organic thermoplastic polymeric structures such as, for example, subjecting the surface of polyethylene film to the action of an open flame emanating from a gas burner, is a now well-known method for rendering the surfaces of such structures adherable to a wide variety of materials as, for example, printing inks, adhesives, and coating compositions. For example, each of U.S. Patents 2,633,921; 2,683,894; 2,704,382; and 2,746,084, discloses a method and suitable apparatus for rendering the surface of polyethylene adherable to printing inks by directing a burning flame against the surface of the polyethylene plastic material either before or after printing thereon and under prescribed conditions of temperature of the burning flame and of the polyethylene material. One of many problems encountered in the use of flame treatment of film or like structures is that of securing or achieving a stable gaseous flame which will provide uniform treatment across the entire width of the particular film, sheet stock or other plastic structure being treated and which will not strike back into the base of the burner when the burning rate of the gas exceeds the rate at which the gas is being supplied to the burner or to prevent blow-off of the flame from the burner when the flow of gas emanating therefrom exceeds the burning rate. The foregoing problem is further aggravated by the fact that the travelling plastic film or structure passing by or through the gaseous flame has a tendency to "sweep" the flame away from the burner. Accordingly, it is the principal object of the present invention to provide an improved device and apparatus for the flame treatment of organic thermoplastic polymeric material that are free of the above-mentioned drawbacks.

The nature and advantages of the invention will be more clearly understood by the following description, the appended claims, and the several views illustrated in the accompanying drawings wherein like reference characters refer to the same parts throughout the several views and in which:

FIGURE 1 is a perspective view of the general arrangement of the improved device and apparatus of the invention;

FIGURE 2 is a cross-sectional view of the burner device employed in the arrangement shown in FIGURE 1;

FIGURE 3 is a cross-sectional view of another embodiment of a burner device for use in the arrangement shown in FIGURE 1.

The burner device and flame treating apparatus herein disclosed in illustration of the invention includes a drum or roll **10** axially rotatably driven by suitable means not shown, satellite rotatable rollers **11** and **12**, located adjacent to and aligned coaxially with drum **10** and a stationary gaseous burner **13** also located adjacent to and preferably aligned coaxially with drum **10**. Burner **13** is provided with suitable inlets **14** for gaseous fuel which is distributed through the entire width of the burner and burned to provide an endless flame **15**. Drum or roller **10** is provided with inlet **16** and outlet **17** for circulating a fluid medium therethrough for regulating the surface temperature of the drum. In operation, polymeric film

material **18** is advanced in the direction of the arrows *a* at a controlled speed and passes, in succession, around roller **11**, drum **10**, and roller **12**. The flame **15** is directed against the surface of the polymeric film **18** as it passes around the drum **10**.

The burner device of the invention is shown more specifically in FIGURE 2 wherein the burner **13** is shown as having an internal passage or chamber **19** extending the entire length of the burner for distributing combustible gaseous fuel therethrough. The combustible gaseous fuel passes from internal chamber **19** through orifice passage **20** and is adapted to be burned at or near orifice lips **21** to provide flame **15**. A grid or screen **22** is located in slot orifice **20** near the discharge opening of the burner and preferably is held in place therein by frictional engagement against the walls of slot orifice **20**. The foraminous grid is preferably preformed and is inserted into the elongated burner opening to a predetermined depth and, as above mentioned, is held in place by friction. A preferred grid construction is a 60 to 100 mesh [1] screen of Nichrome material. Screens of other high temperature resistant materials including metals also can be used, such as those of nickel, copper or iron and screens made of alloys such as, for example, the copper/zinc alloys and especially the nickel/chromium alloys, are most satisfactory because of their good resistance to the high temperatures and oxidizing conditions encountered in use.

The shape or profile of the flame resulting from the use of the above-described burner also is illustrated in FIGURE 2. The "inverted" flame profile is believed to result from the fact that the gaseous mixture passing through the flame grid or screen exits more or less uniformly over the entire burner discharge opening. The gas exiting through the grid near the edges of the burner opening cannot depart perpendicularly from the grid, but is deflected outwardly and the deflection of the gas causes the gas to concentrate or "pile up" along the lip edges of the burner opening and to burn in a more or less "forked" profile. A broader and more stable flame is thus realized.

Another embodiment of the burner device of the invention is shown in FIGURE 3 wherein the grid **23** is located outside slot orifice **20** to overlie the burner opening and preferably is secured to the burner by frictional engagement of each shoulder portion **24** thereof in the respective channels **25** extending longitudinally on the body of burner **13**.

A comparison of the effectiveness of the flame treatment utilizing the burner construction of FIGURES 2 and 3 is indicated herebelow. For the comparison a polyvinyl fluoride film was subjected to flame treatment at a speed of 350 feet per minute with the surface temperature of the supporting drum being held at 80° C. Laminate samples of the treated film were prepared by adhering two layers thereof together with No. 6840 [2] adhesive (a thermosetting aminoacrylic resin mixture), and the resulting laminates were pulley apart and the number of grams required per inch of width of the sample was recorded. The results are shown in tabular form below.

[1] Tyler standard screen scales—a 60 mesh screen has a plurality of openings of 0.0097 inch equivalent diameter.
[2] Manufactured by E. I. du Pont de Nemours and Company.

Sample	Fuel Equivalence Ratio	Grid [3]	Peel Strength (Grams/Inch)
1	1.00	Internal	1,060
2	1.00	External	665
3	1.05	Internal	1,605
4	1.05	External	1,370
5	1.10	Internal	1,530
6	1.10	External	1,610

[3] 70-mesh Nichrome screen.

It is to be noted that the burner equipped with internal grid appeared better suited for higher speed operations in that flame treating speeds of about 1,000 feet per minute could be utilized, whereas, with the external screen arrangement treating speeds of only 600 feet per minute were realized. The greater stability of the internal grid arrangement over the grid arrangement wherein the grid is drawn over the surface of the lips is further illustrated by the fact that the burner having the internal grid and a lip opening gap spacing of 0.150 inch and a gas flow of 0.44 s.c.f.m./inch of opening provided a stable flame and satisfactory performance at a treating speed of 1,000 feet per minute. A burner equipped with an external grid having a burner lip opening of 0.100 inch and a gas flow of 0.34 s.c.f.m./inch resulted in a maximum treating speed of 600 feet per minute. The velocity of the gas exiting from the burner having the internal grid was lower than that of the burner having the external grid, and, despite this fact, the higher treating speeds were permissible with the former burner construction thus indicated by the remarkable and unexpected stability of the inverted flame profile. Furthermore, to accomplish the same film treating result with the burner having the external grid it was necessary to operate at an oxygen ratio of 0.290, whereas the burner having the internal grid provided the same treating effect at an oxygen ratio of only 0.265.

The expression "fuel equivalence ratio" employed herein is defined as the ratio of the amount of hydrocarbon fuel present in the gaseous mixture supplied to the burner to the amount of hydrocarbon fuel necessary for complete stoichiometric combustion. The expression "oxygen ratio" is defined as the ratio of the total amount of oxygen present in the gaseous mixture supplied to the burner to the total amount of non-fuel components in the mixture, these components including chiefly oxygen and nitrogen.

What is claimed is:

1. In an apparatus for flame treating the surfaces of plastic films comprising a rotatably mounted roller adapted to convey said film and to contain a fluid medium for regulating the surface temperature of the roller; means for impinging a flame on the exposed surface of said conveyed film comprising a burner adapted for communication with a supply of combustible gaseous fuel and having a narrow elongated orifice passage terminating in a fuel discharge opening, the improvement comprising a foraminous grid within said orifice passage, said foraminous grid being convex towards said discharge opening so that the center thereof is closer to said discharge opening than the edges thereof.

2. The apparatus of claim 1 wherein said foraminous grid is a Nichrome screen of 60 to 100 mesh.

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