This invention is directed to an improved burner unit for gas stoves or ranges and for gas heating apparatus in general. In the embodiment illustrated, the improved burner unit comprises specifically a Bunsen burner member formed with a circular series of laterally directed flame ports, a pan-shaped metal shell or casing surrounding the burner member and forming a combustion chamber therefor with vents at the top for the products of combustion, the said shell being provided with a raised central portion forming a secondary air chamber within which the burner member is located and having discharge openings leading from the secondary air chamber into the combustion chamber adjacent or in line with the flame ports, and a ring-like bed of refractory material located within the metal shell around the central raised portion and forming the floor of the combustion chamber and adapted to be heated to incandescence by the flame jets. As the burner unit is thus constructed, the secondary air is supplied and distributed in ample quantity to all of the flame jets in order to insure complete combustion under all conditions of use, and the lateral and end heat losses of the flame jets are absorbed and radiated back substantially within the zone of the flamespread. The intense incandescence of the refractory bed in conjunction with the positive and complete aeration of the flame jets permits of combustion over the whole area of the combustion chamber and greatly increases the heating efficiency of the burner unit, and this whether the burner is operating at high or low pressure, it being observed that both the direct and radiant heat of the burner flames are utilized to the fullest extent. The metal shell is also useful in preventing contamination of the secondary air supply by the waste products of combustion, as well as in guarding against back pressure, flame deflection, air currents, and other influences which might interfere with proper combustion or impair the heating efficiency of the burner. The improved burner unit is particularly advantageous in cases where it is desired to locate the burner unit in close proximity to the part to be heated, whether a cooking utensil or some other part, the arrangement being such the flame jets are entirely enveloped with secondary air before they reach or contact with the heated part and the fuel wholly consumed within the limited area of the flamespread. The exact construction of the parts and their advantages will best be understood from the detailed description to follow.

In the accompanying drawings:

Fig. 1 is a vertical section taken through the upper part of a range of the closed-top variety constructed in accordance with this invention;

Fig. 2 is a similar section showing the improved burner unit as applied to a gas range of the open-top variety;

Fig. 3 is a sectional plan view of the improved burner unit as shown in Fig. 1, taken on the line 3—3 of that figure,

Fig. 4 is a vertical section taken on the line 4—4 of Fig. 3;

Fig. 5 is a similar view showing a modified form of metal shell for the burner;

Fig. 6 is a vertical section of an alternative form of burner unit; and

Fig. 7 is a view similar to Fig. 4 and showing another modified form of burner shell.

The improved unit comprises, generally speaking, a Bunsen burner member A, a shell or casing B, and a heat deflector C. The burner member A may be of any desired shape or form, depending largely upon the use to which the unit is to be put, but in the exemplary embodiment herein shown, it is provided with a single circular row or series of nubs A having orifices through which the gaseous mixture issues and which constitute the flame ports of the burner. The fuel is supplied to the burner member, as usual,
through a mixing tube A provided at its entrance end with an air chamber A' into which the gas is discharged from a nozzle A under the control of a stop cock or valve A. In all of the figures, the flame ports are directed laterally, as distinguished from vertically or perpendicularly, the gas nibs A in Fig. 6 extending upwardly at an inclination to the horizontal, and those in the remaining figures extending outwardly in a truly horizontal direction. The invention is primarily concerned with burner members formed with such laterally directed flame ports, having in view the complete elimination of the flame jets and the elimination of the heat losses incident to burners of this type. In this connection it may be stated that here-tofore in the use of burners of the type in question, the secondary air supplied to the burners reaches only the undersides of the burner flames, except possibly a trifling quantity which may percolate through the flames to the upper sides, with the result that imperfect combustion takes place, causing the liberation of poisonous carbon monoxide fumes and lowering the heating efficiency of the burners. This is especially true when the burners are placed close to the cooking utensil or the part to be heated, when back pressure occurs or eddies are created which limit or prevent the percolating action referred to. Moreover, in burners of this type, there is a considerable wastage of the heat units due to the horizontal disposition of the flame jets. In other words, the direct heat of the burner is derived almost entirely from the upper sides of the flame jets, the heat given off by the under sides and tip ends of the flames being largely dissipated instead of concentrated upon the cooking utensil. With this brief explanation, it is believed the utility of the present invention will become more apparent. The shell or casing B, which preferably is made of metal, may likewise be of any desired shape or form, depending largely upon the form or shape of the burner member. In the present instance, the shell is made in the shape of a pan to surround the burner member and has a central raised bottom portion B' to serve as a cover for the burner member. As thus constructed, the space within the pan-shaped shell B constitutes a combustion chamber open at the top to allow the flames to act directly upon the part to be heated, while the space within the cover portion B' constitutes a secondary air chamber containing the burner member and open at the bottom for the admission of air thereto. Communication between the two chambers is established by means of a series of discharge openings B formed in the side wall of the cover portion B' in registry with the flame ports of the burner member. While the gas nibs A might project into or through the secondary air discharge openings B', it is preferred to have them terminate short of the discharge openings as shown, so that in this way the flame jets may directly entrain whatever quantity of secondary air is required to support combustion. In Fig. 2, the pan-shaped shell is shown as being comparatively shallow, its upper edge terminating in a horizontal plane passing through the cover portion B'. In Fig. 6, the shell is also shown as comparatively shallow, although its upper edge terminates in a horizontal plane above the cover portion B'. In this latter instance, while not necessary, the cover portion B' is provided with a depending hood B' to enclose the burner member more completely. In the remaining figures, the pan-shaped shell is shown as considerably deeper, having its upper edge terminating in a horizontal plane located well above the cover portion B'. This latter construction is employed when it is desired to close the combustion chamber at the top, for example as in Fig. 1, hence in such cases the shell is formed near the top with outlet openings or vents B for the products of combustion. The heat deflector C may similarly be of any desired shape or form, depending also upon the form or shape of the burner member, or at any rate upon the disposition of the flame ports, and may be made of any desired material adapted to function in the required manner. In the present instance, the deflector forms the floor of the combustion chamber created by the shell B and is composed of some refractory material, such as fireclay, which is adapted to be heated to incandescence by the flame jets, and which will absorb the heat losses of the flame jets and radiate them back substantially into the zone of the flamespread. In the forms shown, the deflector is laid in a ring-like bed in the bottom of the shell B around the central raised cover portion B' and has its upper or radiating surface curved upwardly and outwardly from a horizontal plane located below the secondary air discharge openings B'. In Fig. 6, the curvature is made more abrupt, in order to conform to the upward inclination of the flame jets which contact with the radiating surface at their under sides only. In the remaining figures, the curvature is more gradual and is made so that the flame jets (which are projected outwardly in a truly horizontal direction) will contact with the radiating surface at their tip ends as well as at their under sides. It is pointed out, however, that in both cases the refractory bed is so shaped that its radiating surface will contact only with the outer or feather parts of the flame jets and not with the inner or cone parts thereof, thereby permitting combustion to take place without interference or disturbance. It will now be seen that, in the operation of the improved burner unit, the secondary
air is supplied to the burner in pure atmospheric condition and without contamination by the waste products, being drawn up through the open bottom of the secondary air chamber and then entrained from said chamber directly by the flame jets as they project through the discharge openings B into the combustion chamber formed by the shell B. Since the discharge openings entirely surround the flame ports, each flame jet will be entirely enveloped with secondary air in order to produce complete combustion. In other words, notwithstanding the lateral disposition of the flame ports, the secondary air will reach, not merely the under sides of the flame jets, but every part thereof and in quantities regulated by the flame jets themselves. As the flame jets enter the combustion chamber, they contact with the radiating surface of the refractory bed B (which, incidentally, may be plain, as shown, or nodular or of any other desired configuration), heating it to incandescence. As before explained, in the embodiment shown in Fig. 6, only the lower sides of the flame jets will impinge against the refractory bed, the upper sides and tip ends of the jets being adapted to play directly upon the part to be heated through the open top of the shell B, while in the embodiments illustrated in the other figures, both the lower sides and tip ends of the jets will impinge against the refractory bed, the upper sides of the jets only being utilized for direct heating. In both cases, however, the heat absorbed by the refractory bed, which would otherwise be lost or wasted, is radiated back into the zone of the flamespread and concentrated upon the part to be heated, so that such part (whether a cooking utensil, a stove plate, or other part) will be subject to both the direct and radiant heat of the burner flames. The refractory bed, in addition to the performance of the important functions just noted, also aids in promoting combustion, serving by its incandescence to heat and consume any unburnt gases which may enter the combustion chamber from the flame ports. In fact, the flame jets will spread and form practically a continuous sheet of flame covering the entire radiating surface of the refractory bed, although still confined to that area. In this way, an intense heating effect may be produced within the limited area of the combustion chamber without interfering with proper combustion and with the minimum consumption of fuel.

While the various elements composing the improved burner unit cooperate in a peculiar way in producing the results aimed at, nevertheless they perform individual functions which might be useful alone or in other arrangements as well. For instance, the cover B could be used alone (i.e., without the rest of the shell B or the heat deflector C) to good advantage, serving, in addition to the functions above noted, to protect the Bunsen burner against the heat of the products of combustion and thus lessening the tendency to cause an excessive expansion of the contained gas, such as would reduce the entrainment of the primary air. On the other hand, the air pocketed within the cover becomes heated by the products of combustion and may therefore be more effectively entrained at the flame ports. It is also pointed out that, due to the restricted areas of the discharge openings B, the pressure of the products of combustion at the flame ports is reduced to a minimum, thereby lessening the tendency to back pressure and hence more nearly preserving the initial entrainment of the primary air. Moreover, the cover protects the burner from outside disturbances and serves as a shield to prevent the clogging up of the flame ports by drippings or other foreign substances falling from above. Similarly, the refractory bed C or the shell B, without the cover portion B, might be used alone to perform their independent functions, although it would be desirable in either case to provide in some way for the proper aeration of the burner flames. The use of the refractory bed C in connection with the cover portion B would make a very desirable unit, lacking only the advantage of an enclosed combustion chamber, which, however, would be constituted in part by the refractory bed itself. Likewise, the use alone of the shell B with the cover portion B would be advantageous, although lacking the advantages derived from the use of the refractory bed C. However, some of these advantages might be realized by polishing or enameling the lower portion of the shell so as in that way to direct or reflect the heat losses of the flame jets upwardly into the zone of the flamespread.

In all of the constructions above described, the metal shell B is shown as separate from the burner member and as detachably secured thereto, as will be more fully described hereinafter. This arrangement is preferred for reasons of economy and for the further reason that the shell may be readily removed to permit the cleaning, repair, or replacement of the individual parts. It should be noted, however, that it would be entirely feasible to make the shell, or its cover portion B when used alone, integral with the burner member, as by casting, and this is contemplated by the present invention. It should also be noted that it is not absolutely essential that the secondary air chamber formed by the cover B be common to all of the discharge openings B, as in the embodiments illustrated, but that a number of such chambers might be provided to serve the discharge openings individually or in groups.

In Fig. 1 the improved burner unit is illustrated as embodied in a gas range of the type covered in my prior Letters Patent No.
1,403,814. As shown, the range comprises an oven 2 and a closed smooth-surfaced cooking top 3, the latter being arranged above and in spaced relation to the top wall 4 of the oven and extending rearwardly beyond the back wall 5 of the range and formed throughout its length with a series of outward openings or vents 9 adapted to discharge into a flue 1 the products of combustion issuing from both the top burners and the oven burner. At this point it may be noted that the products of combustion from the oven 2 pass off through a top flue 10 communicating at the rear through openings 11 with an outlet chamber or pocket 12 having a narrow passage 13 registering with the vents 9. A burner plate 18 (preferably made of cast iron) is located in the space between the closed cooking top 3 and the oven top wall 4 and provides in effect an upper heat generating chamber 19 and a lower secondary air compartment 20. As shown, the burner plate is arranged in close parallel relation to the overlying cooking top 3 so as to provide a shallow heat generating chamber which will serve to heat the entire top whether one or more of the burners are in operation at a time. In this connection it may be stated that it is proposed to employ a plurality of burner units below the forward portion of the cooking top, although only one is shown in Fig. 1. The burner plate 18 is recessed at the front to receive the burner unit and is designed to exclude secondary air from the heat generating chamber except that which is entrained by the burner flames. In providing for the support of the burner unit, the shell or casing B is provided at its upper edge with an annular flange B² which seats upon a similar flange 21 formed around the edge of the lid opening 22 of the cooking top 3, the two flanges being sufficiently depressed to receive and give support to the customary lid 23 flush with the upper surface of the cooking top.

As thus arranged, the shell B becomes a supporting member for the burner A which is suspended therefrom by means of a cotter pin D passed through a perforated lug D¹ extended upwardly from the burner through an aperture in the top of the cover portion B¹ (see also Fig. 4). As will be observed, the shell B is of the same diameter as the lid opening, so that the combustion chamber formed within the shell is limited to the area of the lid opening; hence when a cooking vessel is placed in the lid opening or upon the lid, the direct and radiant heat of the burner may be concentrated thereon, the arrangement being such that the burner flames may be brought as close to the top as desired without danger of interfering with proper combustion. The waste products leave the combustion chamber through the vents B³ of the shell B and enter the heat generating chamber 19, flowing rearwardly therethrough and escaping into the flue 1. In escaping, the waste products are caused to give up their heat to the overlying rear portion of the cooking top, which may thus be said to possess a secondary calorific surface available for slow cooking and warming up or keeping hot such food as may already have been cooked. The heating capacity of the escaping products is greatly increased by the shallow character of the heat generating chamber, due to the close proximity of the burner plate 18 with the cooking top 3, the products being caused to pass between the two without substantial expansion in a stratum of substantially uniform character which imparts practically the whole of its heat to the cooking top on the one hand and the burner plate on the other. The burner plate becoming hot, will in turn radiate its heat to the overlying cooking top and aid further in promoting the heating efficiency of the range in this respect. Moreover, some of the heat radiated from the burner plate will be imparted to the air entering the underlying secondary air compartment 20 and hence enable the air to be more effectively entrained at the flame ports. The effect above described will take place whether one or more of the burners are in operation at the same time, although necessarily the maximum heating effect will be obtained by the use of all the burners simultaneously. Once the cooking top is heated, one burner alone will keep it hot, since the heat generating chamber is substantially coextensive with the top and allows the heated products of combustion to be distributed uniformly throughout the entire under surface of the top. The behavior of the burner unit will have been understood from the foregoing description, it being apparent that no secondary air can enter the heat generating chamber except that which is entrained through the discharge openings B² by the flame jets directly. It hardly needs to be stated that the secondary air will be drawn in from the compartment 20 through the secondary air chamber formed by the cover B¹.

In cases where the diameter of the lid opening is larger than that of the shell B, the latter may be flared outwardly at the top, as shown in Fig. 5, to allow the supporting flange B² to fit properly within the opening. In Fig. 7, the shell B is shown as integral with the burner plate 18, this being a suitable construction when the burner unit is intended to be used exclusively in a range such as that above described. In this case, the burner unit will, of course, be supported by the burner plate, and hence the flange B² may be omitted, although it is still desirable to extend the shell upwardly to make contact with the cooking top so as to shut off communication between the combustion chamber and the heat generating chamber, except through the vents B³.

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Fig. 2 illustrates one of the burner units as applied to a range of the open-top variety, that is to say, a range equipped with an open or grate top 30. In this instance, the burner member A is shown as the supporting element, being formed on its underside with a recessed lug D resting upon a supporting rod D in a well-known manner. However, the connection between the burner member and the shell B is precisely the same as before. The shell B here shown is of the shallow type, which is most desirable for ranges of the open-top variety. The burner unit illustrated in Fig. 6, being of the shallow type, is also best suited for an open-top range, although of course it may be used in connection with a closed-top range. In this latter figure, the burner member A is supported as in Fig. 2, but the depending hood B is recessed as at B to fit over the mixing tube A.

The invention is not, of course, confined to the precise constructions shown and described, nor to any particular construction by which the same may be carried into effect, as many changes may be made in the details thereof without departing from the main principles of the invention and without sacrificing its chief advantages. It should be understood, therefore, that the invention is not limited to any specific form or embodiment, except in so far as such limitations are specified in the claims.

Having thus described my invention, its construction and mode of operation, what I claim and desire to secure by Letters Patent of the United States, is as follows:

1. A burner unit for gas heating apparatus comprising a Bunsen burner member formed with a circular series of laterally directed flame ports, and a pan-shaped shell surrounding said burner member and forming a localized combustion chamber therefor, the said shell being provided with a raised central portion forming a secondary air chamber wherein the burner member is located, and having openings in its side wall leading from the secondary air chamber into the combustion chamber adjacent the flame ports.

2. A burner unit for gas heating apparatus comprising a Bunsen burner member formed with a circular series of laterally directed flame ports, a pan-shaped shell surrounding said burner member and forming a localized combustion chamber therefor, the said shell being provided with a raised central portion forming a secondary air chamber wherein the burner member is located, and having openings in its side wall leading from the secondary air chamber into the combustion chamber adjacent the flame ports, and a ring-like belt of refractory material located within the pan-shaped shell around the central raised portion in position for contact with the flame jets and forming the floor of the combustion chamber.

3. A burner unit for gas heating apparatus, comprising a Bunsen burner member formed with a series of laterally directed flame ports, a pan-shaped shell surrounding the burner member and forming a localized interior combustion chamber and a localized exterior secondary air chamber, said shell being formed with openings leading from the secondary air chamber into the combustion chamber adjacent the flame ports and also formed at the top with vents for the products of combustion.

4. A burner unit for gas heating apparatus comprising a shallow combustion chamber and a Bunsen burner member, one of said elements surrounding the other, the combustion chamber having a side wall extending entirely around the same and formed throughout its extent with secondary air openings, and the Bunsen burner member being located outside the combustion chamber and formed in its side and throughout its extent with a series of laterally directed flame ports arranged in registration with the secondary air openings and adapted to project the flame jets therethrough into the combustion chamber.

5. A burner unit for gas heating apparatus comprising a horizontally disposed shallow combustion chamber having a bottom wall composed of refractory material and presenting an endless side wall formed throughout its extent with secondary air openings arranged above the level of the refractory material, and a horizontally disposed Bunsen burner member located outside the combustion chamber and formed in its side with an endless series of flame ports registering with the secondary air openings and adapted to project the flame jets therethrough into contact with the refractory material within the combustion chamber.

6. A burner unit for gas heating apparatus comprising a Bunsen burner member formed in its outer periphery with a series of laterally directed flame ports, and a pan-shaped shell having a dome-like cover forming a secondary air chamber wherein the burner member is located, and an exterior flanged portion forming a combustion chamber around the secondary air chamber, the said dome-like cover being formed in its side wall opposite the flame ports with a series of openings leading from the secondary air chamber into the combustion chamber and through which the flame jets project from the former into the latter.

7. A burner unit for gas heating apparatus comprising a Bunsen burner member formed in its outer periphery with a series of laterally directed flame ports, and a pan-shaped shell having a dome-like cover forming a secondary air chamber wherein the burner member is located, and an exterior flanged portion forming a combustion chamber.
around the secondary air chamber and lined with a bed of refractory material, the said dome-like cover being formed in its side wall opposite the flame ports with a series of openings leading from the secondary air chamber into the combustion chamber and through which the flame jets project into direct contact with the bed of refractory material.

In testimony whereof, I have affixed my signature hereto.

HENRY W. O'DOWD.