Sept. 6, 1966 A. WESTERMAN ET AL 3,270,967

GAS BURNERS

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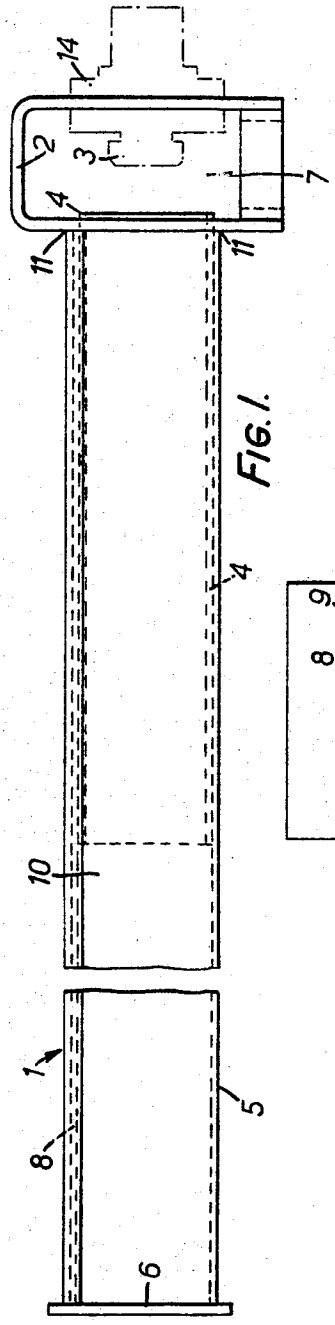


FIG. 1.

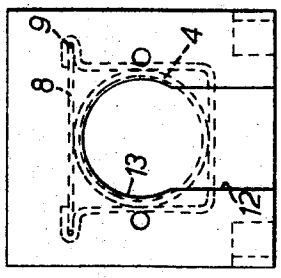


FIG. 2.

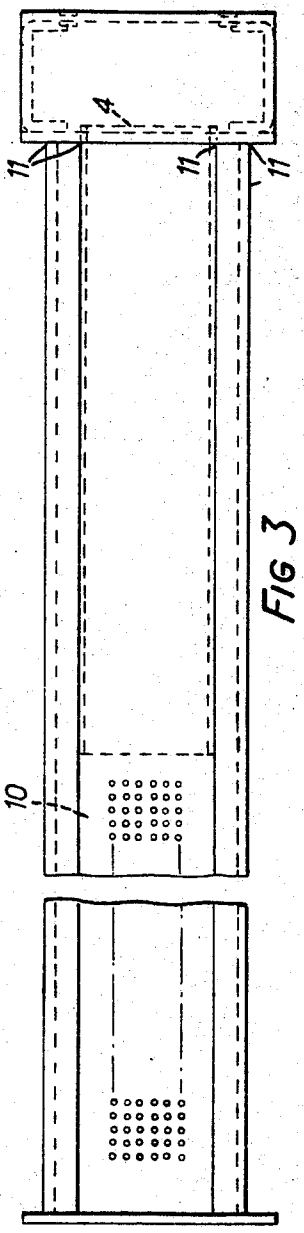


FIG 3

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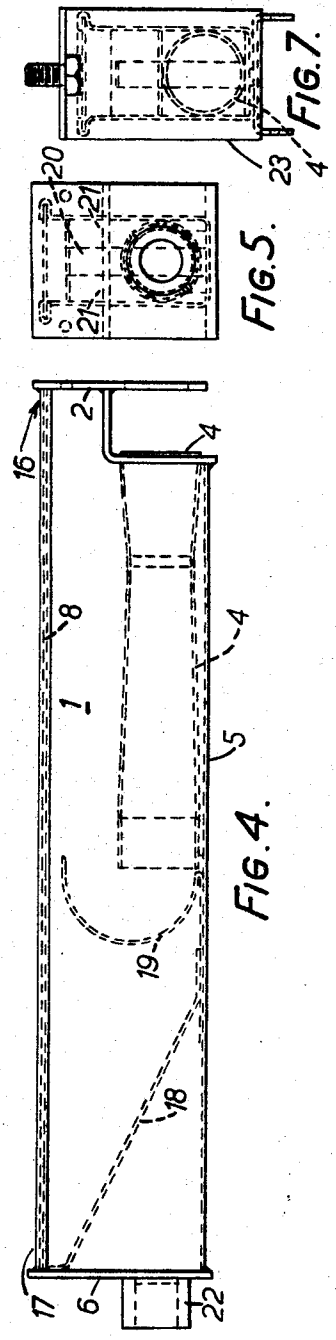


FIG. 7.

FIG. 5.

FIG. 4.

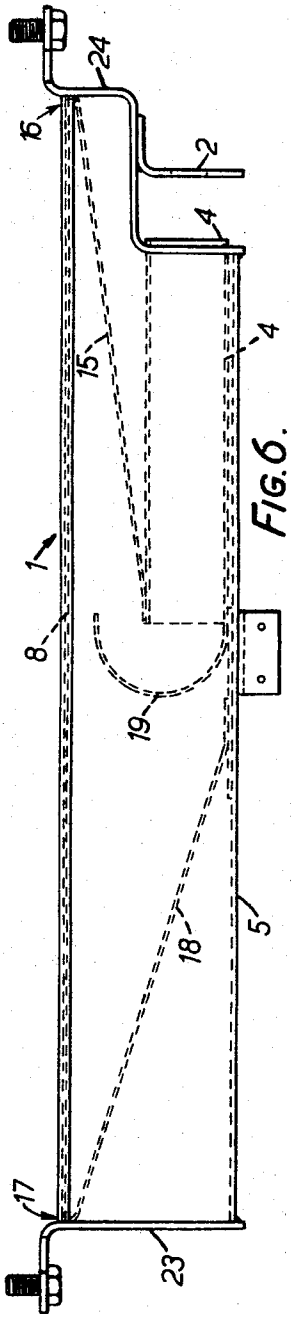


FIG. 6.

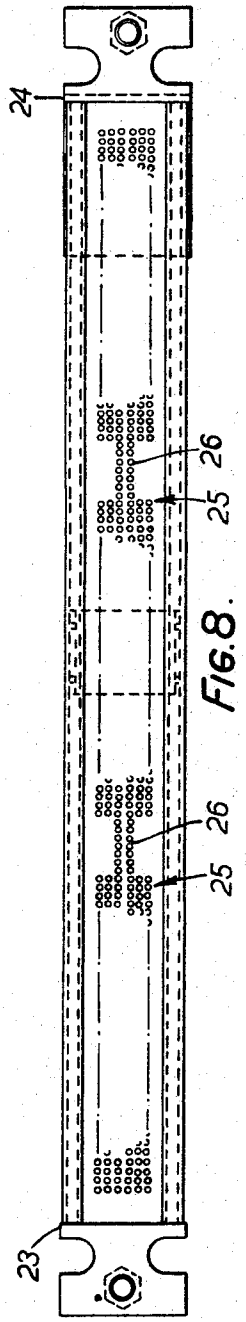


FIG. 8.

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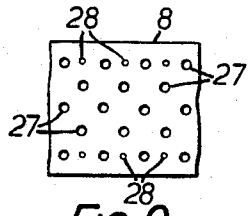


FIG. 9.

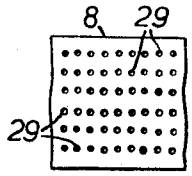


FIG. 10.

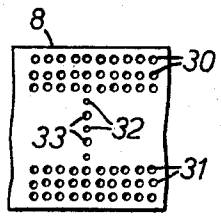


FIG. 11.

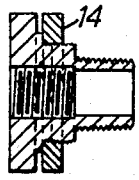


FIG. 12.

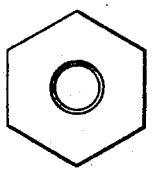


FIG. 13.

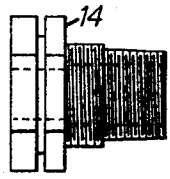


FIG. 14.

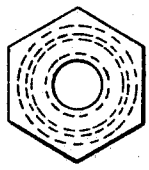


FIG. 15.

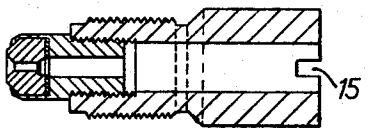


FIG. 16.

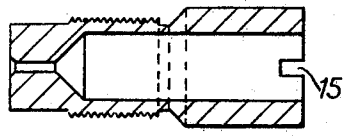


FIG. 17.

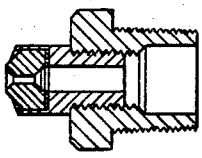


FIG. 18.



FIG. 20.

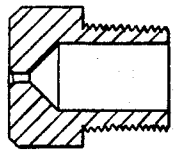


FIG. 19.

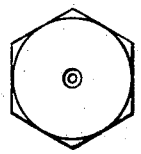


FIG. 21.

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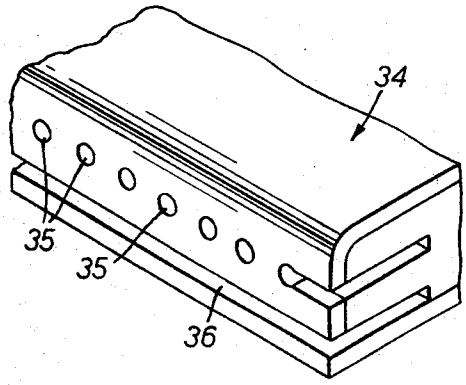


FIG. 22.

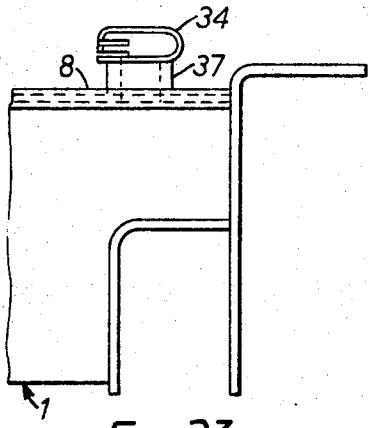


FIG. 23.

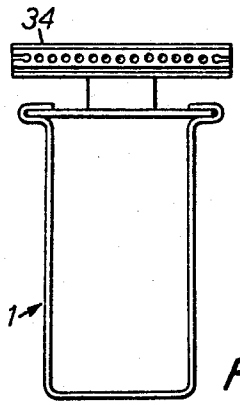


FIG. 24.

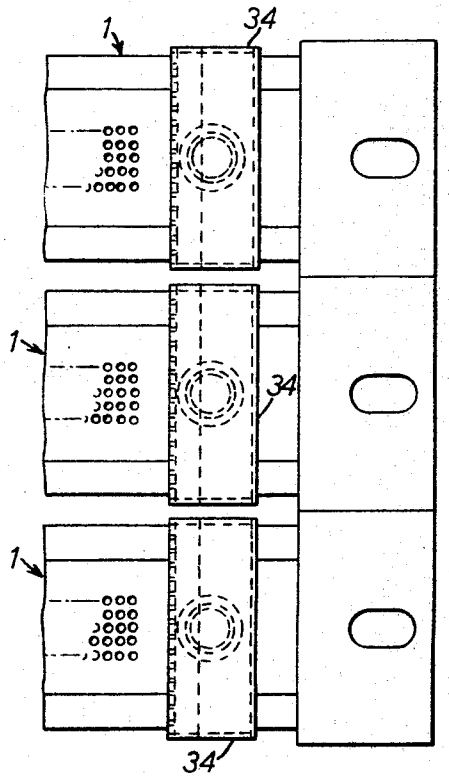


FIG. 25.

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United States Patent Office

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GAS BURNERS

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Filed Jan. 10, 1964, Ser. No. 337,503
Claims priority, application Great Britain, Jan. 18, 1963, 2,357/63
8 Claims. (Cl. 239—560)

This invention relates to gas burners of the aerated type and has for its object to provide a burner which is suitable for use with gases having differing compositions and qualities.

For a long period gas used in domestic and industrial appliances has been produced from coal but there are now available such gases as the liquefied petroleum gases, butane and propane. Natural gases, including methane, are also available in quantity. These several gases have differing combustion characteristics which have necessitated the design and manufacture of burners appropriate for use with specific gases. It is well established, for example, that small flame ports must be used for coal gases to prevent lighting back of the flame and that large flame ports must be used for hydrocarbon gases to prevent flame lift. If it is desired to use the same burner for all gases, a compromise has to be accepted in that a drastic reduction in the thermal rating in the case of the gases having a slower burning rate than coal gas has to be tolerated. The distribution of the gases and the use of the burners have, however, been confined to fairly well defined areas and a manufacturer has known in advance the gas or gases for which a burner had to be designed.

The increasing availability of hydrocarbon gases, the shortage of good gas-making coal and general economic factors are, however, bringing about a change in the gas quality position throughout Europe. Coal gases are being enriched with hydrocarbon gases and the latter are being diluted with air or reformed to give lower calorific values. Thus, a gas of calorific value 500 B.t.u.'s per cubic foot, could be normal coal gas or enriched coal gas, a mixture of propane and air or a reformed natural gas and so on, each gas having different combustion characteristics. The gas quality position is epitomised in Holland where standardization is based upon three Wobbe number groups and the relationship between calorific value and specific gravity. The gases within each Wobbe group have the same heating value but can have widely different combustion characteristics. Testing requirements specify that the one burner shall be capable of use with any gas within any of the Wobbe groups irrespective of the combustion characteristics of that gas and without the burner being changed in any way. It is necessary also for the same burner to be made suitable for use with gases again of differing combustion characteristics in another Wobbe group simply and only by changing the injector to allow for the different heating value.

According to the present invention, a gas burner is provided with a plurality of symmetrically arranged flame ports each having a diameter of the order of 0.030 to 0.060 of an inch, the ports being formed in a strip of heat resisting metal such that each flame port diameter is between 0.8 and 2.0 times the thickness of the metal strip, the flame ports being spaced at centres of between 2 and 4 times the flame port diameter.

The combination of small flame ports in a thin metal strip gives rapid dissipation of heat and results in the provision of a burner which is practically flameproof for all gases. The concentration of a number of small diameter flame ports provides in effect large flame port areas which have the effect of avoiding flame lift. Again, the

symmetrical arrangement and constant spacing of the flame ports, one from another, provides an additional advantage in that the flame on each individual flame port stabilizes its neighbour and acts as a flame retention device which further inhibits flame lift.

In preferred constructions of burner embodying the invention, between 2 and 10 rows of flame ports are provided along the length of the metal strip so that the flame port area and hence the heat input per unit inch may be varied between quite wide limits. The flames on the two outer rows of flame ports are not surrounded on all sides by similar retaining flames and according to a further feature of the invention, in cases where flame lift may be particularly severe, there is provided between each pair of flame ports in the two outer rows, an additional flame port at half the normal spacing and of a smaller diameter equal to 0.8 to 1.2 times the thickness of the metal flame strip. In carrying out the invention, between 2 and 10 parallel rows of flame ports with equal spacing may be used and any number of such rows in parallel arrangement with other rows at a greater spacing may be used to allow for entrainment of secondary air, the two groups of flame ports being connected together for interlighting purposes by a number of subsidiary flame ports. Thus, for example, a flame strip may have two parallel groups of four rows of flame ports as previously indicated with a spacing between the inner rows of the two groups of at least 4 times the normal spacing.

In certain applications of the invention the flame ports may be centrally disposed along the length of the flame strip or they may be offset according to any specific requirement the burner is intended to fulfill. Again, the flame strip may be flat, convex or of frusto conical shape as required by the environment of the burner in order to allow free access of secondary air.

The burner body incorporating a flame strip having flame ports arranged in accordance with the invention may be made as a casting, a pressing or it may be in channel form made from sheet or extruded metal. The cross-section of the burner body may be of any convenient shape, for example, square, rectangular or circular, providing that it is designed to be uniformly filled by the gas/air mixture flowing to the flame ports. The cross-sectional area of the burner body should bear such a relationship to the flame port area that the gas/air mixture has adequate potential energy for its expulsion from the flame ports.

In burners embodying the invention, the gas/air mixture is produced by the conventional use of an injector unit and a cylindrical mixing tube or venturi. Preferably the mixing tube or venturi is connected to the burner body by any conveniently appropriate means and may be disposed at the end of and in line with the burner body, thus forming a long bar burner. Alternatively, the mixing tube or venturi may be disposed within the burner body at one end but well below the flame strip, this construction resulting in a more compact unit and allowing the flame strip to extend along the whole upper surface of the burner. Long burner bars with the venturi situated at one end normally require the use of a device to ensure uniform distribution of the gas/air mixture to the flame ports. This may be achieved by varying the cross-sectional area of the flame ports along the length of the burner, by varying the internal cross-sectional area of the burner body or by the use of an internal baffle. In certain applications of the invention, advantage can be taken of the use of the smallest diameter flame ports, these requiring no additional gas/air mixture distributing devices. In such cases also the burner body and the flame ports may be of uniform and constant area.

Alternative forms of burner constructed in accordance with the invention will now be more fully described by

way of example with reference to the accompanying drawings in which:

FIGURE 1 is a side elevation in section of one such burner,

FIGURE 2 is an end view of the burner shown in FIGURE 1,

FIGURE 3 is a plan view of FIGURE 1,

FIGURE 4 is a side elevation in section of a modified form of burner,

FIGURE 5 is an end view of the burner shown in FIGURE 4,

FIGURE 6 is a side elevation in section of a further modified form of burner,

FIGURE 7 is an end view of the burner shown in FIGURE 6; and

FIGURE 8 is a plan view of that burner,

FIGURES 9, 10 and 11 are fragmentary views of portions of burner flame strips each showing a different arrangement of flame ports,

FIGURE 12 is a sectional elevation of one form of injector body,

FIGURE 13 is an end view of FIGURE 12,

FIGURE 14 is a sectional elevation of an alternative form of injector body,

FIGURE 15 is an end view of FIGURE 14,

FIGURES 16 and 17 are sectional elevations of injector jets shown to an enlarged scale and which can be used in conjunction with the injector bodies referred to,

FIGURES 18 and 19 are sectional elevations of alternative forms of injector jets; and

FIGURES 20 and 21 are respectively end views of the jets shown in FIGURES 18 and 19,

FIGURE 22 is a fragmentary perspective view of a cross-lighting device for use when several burners embodying the invention are built to form an assembly,

FIGURE 23 shows a cross-lighting device mounted on a burner embodying the invention, a portion of the latter only being shown,

FIGURE 24 is an end view of FIGURE 23; and

FIGURE 25 is a plan view showing portions of three burners forming an assembly and having cross-lighting devices mounted thereon.

Referring to the drawings, in FIGURES 1, 2 and 3 a burner bar indicated generally at **1** is provided with a mounting bracket **2** which will be described in detail below and carries an injector **3**, a mixing tube **4** and the burner body **5**. A plate **6** provides support for the end of the burner body remote from the injector. The mixing tube **4** is so disposed that it is coaxial with respect to the burner body and allows for entry of air through ports **7**.

A strip of heat resistant metal **8** is positioned along the top of the burner body and is held in place in grooves **9** situated at each side and along the length of the burner body. The grooves are formed by appropriately bending or otherwise forming the metal of which the burner body is composed. The flame strip is perforated to form flame ports, alternative patterns of flame ports being shown in FIGURES 9, 10 and 11 to which reference will be made hereinafter. The effective, or in other words the perforated length of the flame strip, commences in the region of the end **10** of the mixing tube and extends along the remaining length of the burner body or along such part of that length as required by the particular use to which the burner is to be put.

The bracket **2** consists of a strip of metal formed into an inverted U shape and is attached to the burner at **11**. The side of the bracket adjacent to the burner is formed with a circular hole within which the end of the mixing tube **4** fits. The opposite side of the bracket has a keyway **12** into which may be fitted one or the other of the injector bodies shown, as examples, in FIGURES 12 and 14. The injector body fits in the circular part **13** of the key **12** thus ensuring that the injector jet **3** of which examples are shown in FIGURES 16, 17, 18 and 19 are correctly aligned with the mixing tube **4**. A nut **14** serves to clamp the injector body to the bracket **2** carrying the burner and when the nut is slackened the burner may be lifted off the injector body which will normally be fastened to a burner supply pipe or manifold. The injector jet may thus be exchanged for another without breaking the gas connection.

The injector body shown in FIGURES 14 and 15 and one or the other of the injector jets shown in FIGURES 16 and 17 are further designed so that it is not necessary to remove even the burner before changing the jet. The injector body is designed for use with a blind T piece. The body is attached to one side of the T junction the other side of which is sealed by means of a screwed plug. The gas connection is made to the stem of the T. The injector jet is inserted or removed by removing the screwed plug and screwing the jet in or out of the injector body by means of the screwdriver slot **15**. This method of changing the injector jet is convenient when the burner is situated inside a sealed combustion chamber as in balanced flue heaters. In such cases the wall of the combustion chamber is sandwiched between the injector carrying bracket **2** and the nut **14** of the injector body.

The burner shown in FIGURES 4 and 5 of the drawings is in general of similar construction to that shown in FIGURES 1, 2 and 3 but the effective portion of the flame strip extends along the full length of the burner, that is to say between the positions identified by the references **16** and **17**. Also, in the burner shown in FIGURES 4 and 5 the injector unit and mixing tube are disposed at a greater distance below the flame strip than in the case of the burner shown in FIGURES 1, 2 and 3, these devices being disposed in a rather deeper channel in order to allow the combustible mixture to flow to the flame ports at or in the vicinity of the position **16**. The uniform distribution of the gas/air mixture to the flame ports requires the use of baffling devices **18, 19** which, for the purposes of the example being described with reference to FIGURES 4 and 5, are each made from strip metal of width equal to that of the inside of the burner channel.

The curved baffle **19** is formed with a central slot **20** (FIGURE 5). Part of the gas/air mixture issuing from the end of the mixing tube passes through the slot **20** to the flame ports at the left of the baffle. The solid side portions **21** of the curved baffle direct the remainder of the gas/air mixture back to the flame ports above the mixing tube. The curved baffle is provided essentially therefore to ensure uniform distribution of the gas/air mixture and hence of the flame, along the length of the burner.

It will be seen from FIGURES 4 and 5 that the form of the bracket **2** is modified as compared with the bracket shown in FIGURES 1, 2 and 3. Thus, in FIGURES 4 and 5 the bracket **2** has a flat face and is intended for use in a sealed combustion chamber but has a U shaped portion, as shown, corresponding with the bracket **2** of FIGURES 1, 2 and 3. The plate **6** has a spigot attachment **22** and the arrangement described allows direct interchangeability of the burner with a pipe into which non aerated jets are screwed, the main type of turner previously used with towns gas, with the minimum of modification of the appliance.

Referring now to FIGURES 6, 7 and 8, it will be seen that the burner shown has features in common with the burners already described but the support means take the form of inclined brackets **23** and **24** the latter being combined with the bracket **2**. The support brackets are provided at each end of the burner to enable it to be supported below a combustion chamber as in the British type of radiant fires or heaters. Such fires or heaters have either a continuous combustion chamber with bar radiants extending across the front or three or four block type radiants. In the latter case, the walls of the

radiants break up the combustion chamber into three or four smaller ones depending upon the number of radiants. It is then necessary to have individual blocks or flames and FIGURE 8 shows a flame strip with flame ports disposed in blocks indicated generally at **25**, each block being interconnected by means of two rows of interlighting ports.

FIGURES 9, 10 and 11 show possible patterns of flame ports which can be used with burners as shown in FIGURES 1, 2 and 3 or FIGURES 4 and 5. The main flame ports **27** in FIGURE 9 each has a diameter of 0.040 inch in metal of 0.032 inch thickness and are arranged in parallel rows at centres of 0.100 inch. In the outer rows of main flame ports, additional ports **28** are provided these ports each having a diameter considerably less than the diameter of the individual main flame ports **27**.

The flame strip shown in FIGURE 10 has a large number of parallel rows of flame ports **29**, these flame ports having sufficiently small individual diameters while of adequate concentration per unit area to ensure that neither lighting back nor flame lift will occur.

The flame strip illustrated in FIGURE 11 provides an example of several rows of main flame ports **30** spaced from another row of flame ports **31** with intermediate rows of flame ports **32** of smaller diameter alternating with rows of flame ports **33** of the same diameter as those in the rows **30** and **31**.

While the burners described are normally used singly in most domestic appliances, in central heating boilers, both domestic and industrial, several burners may be used. The burners may also be used severally in commercial and industrial applications. When more than one burner is used, present day regulations usually require the use of only one pilot jet used in conjunction with a flame failure device. It is desirable therefore, that all burners ignite very quickly, almost instantaneously from one pilot flame.

It is very difficult to achieve the desired simultaneous ignition because the burners may be used at as much as six inch centres. Accordingly, FIGURES 22 to 25 show a crosslighting device for use with burners embodying the present invention.

Referring to FIGURE 22, the crosslighting device indicated generally at **34** is made from a strip of metal in which one row of flame ports **35**, subjected to the same criteria as already described in connection with the flame ports in the burners themselves, are formed before the metal is folded. After folding, the ports are situated immediately above a slot **36**, approximately equal in width to the thickness of the metal, formed during the folding operation.

The crosslighting device **34** is attached to the flame strip **8**, as shown in FIGURE 23, by a hollow spigot **37** through which gas/air mixture flows from inside the body of the burner. A ribbon of flame is formed by the crosslighting device immediately in front of and at right angles to the main burner flame issuing from the main flame ports. By making the crosslighting device to extend across about half the space between burners as

shown in FIGURE 25, very rapid ignition of all burners follows ignition of one burner by a single pilot flame. In some cases the pilot can be used in between two of the crosslighting devices.

We claim:

1. A gas burner having a plurality of symmetrically arranged flame ports each having a diameter of the order of 0.030 to 0.060 of an inch and being formed in a strip of heat resisting metal such that each flame port diameter is between 0.8 and 2.0 times the thickness of the metal strip, the flame ports being spaced at centres of between 2 and 4 times the flame port diameter.

2. A gas burner according to claim **1** in which the strip in which the flame ports are formed is flat and constitutes a wall of an elongated box another wall of which has provision for attachment of an interchangeable injector jet.

3. A gas burner according to claim **2** in which the elongated box is of square, rectangular or circular cross-section.

4. A gas burner according to claim **1** in which the strip in which the flame ports are formed constitutes a wall of an elongated box another wall of which has provision for attachment of an interchangeable injector jet.

5. A gas burner according to claim **1** in which the strip in which the flame ports are formed constitutes a wall of an elongated box which accommodates a mixing tube and another wall of the box has provision for attachment of an interchangeable injector jet.

6. A gas burner according to claim **1** in which the flame ports are arranged in a plurality of parallel rows.

7. A gas burner acccording to claim **6** in which the flame ports are arranged in a pattern comprising at least four rows and between each two adjacent ports in each of the two outermost rows there is an additional flame port at half the spacing of the flame ports in the remaining rows, the additional flame ports being of smaller diameter than those flame ports.

8. A gas burning assembly comprising a plurality of parallel transversely spaced burners as claimed in claim **1**, and a crosslighting device positioned transversely of each burner for projecting flame therefrom into the space between that burner and an adjacent burner.

References Cited by the Examiner

UNITED STATES PATENTS

1,507,791	9/1924	Parker	158—114
1,729,149	9/1929	Brown et al.	158—114
1,754,546	4/1930	Delling	158—114

OTHER REFERENCES

Fundamentals of Design of Atmospheric Gas Burner Parts, Research Bulletin No. 13, Second Bulletin-Project No. 3. American Gas Association Testing Laboratories Cleveland, Ohio, August 1942, pages 6, 7, 8, 9, 16, 17, 18, 19, 21, 43, 48, 49, 51, 63, 66, 67, 115.

EVERETT W. KIRBY, *Primary Examiner.*