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HEATING APPARATUS

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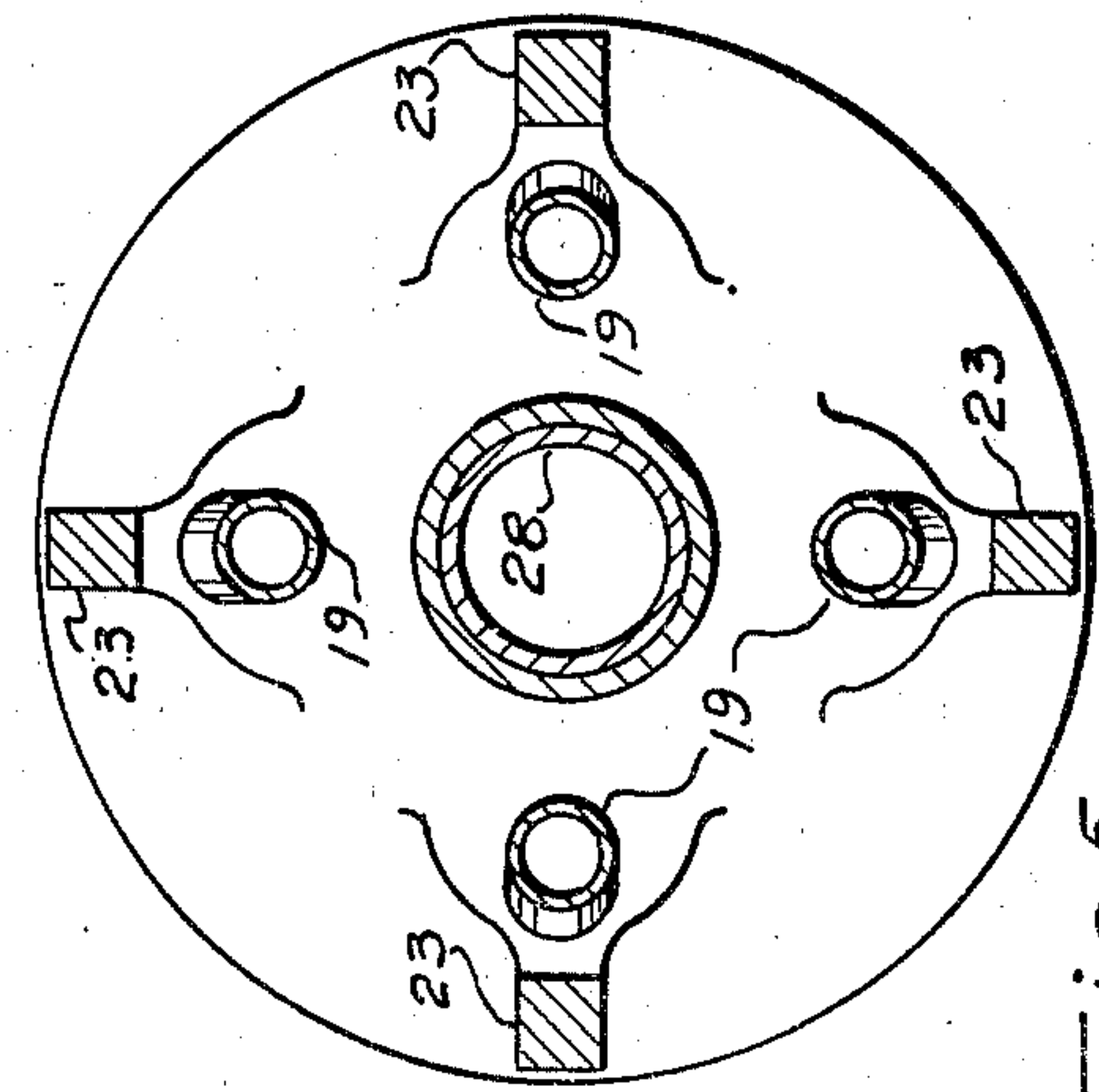
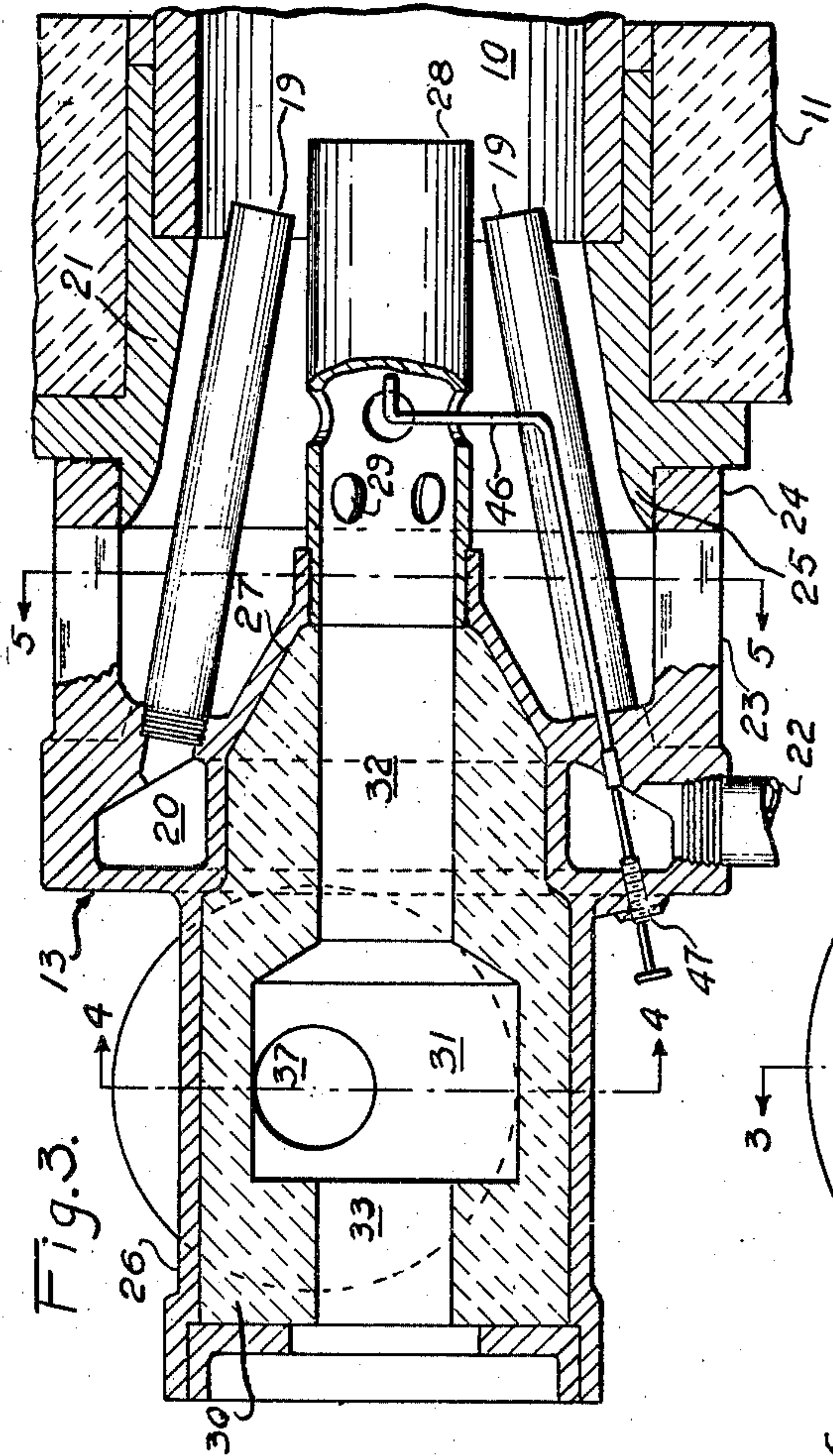


Fig. 5.

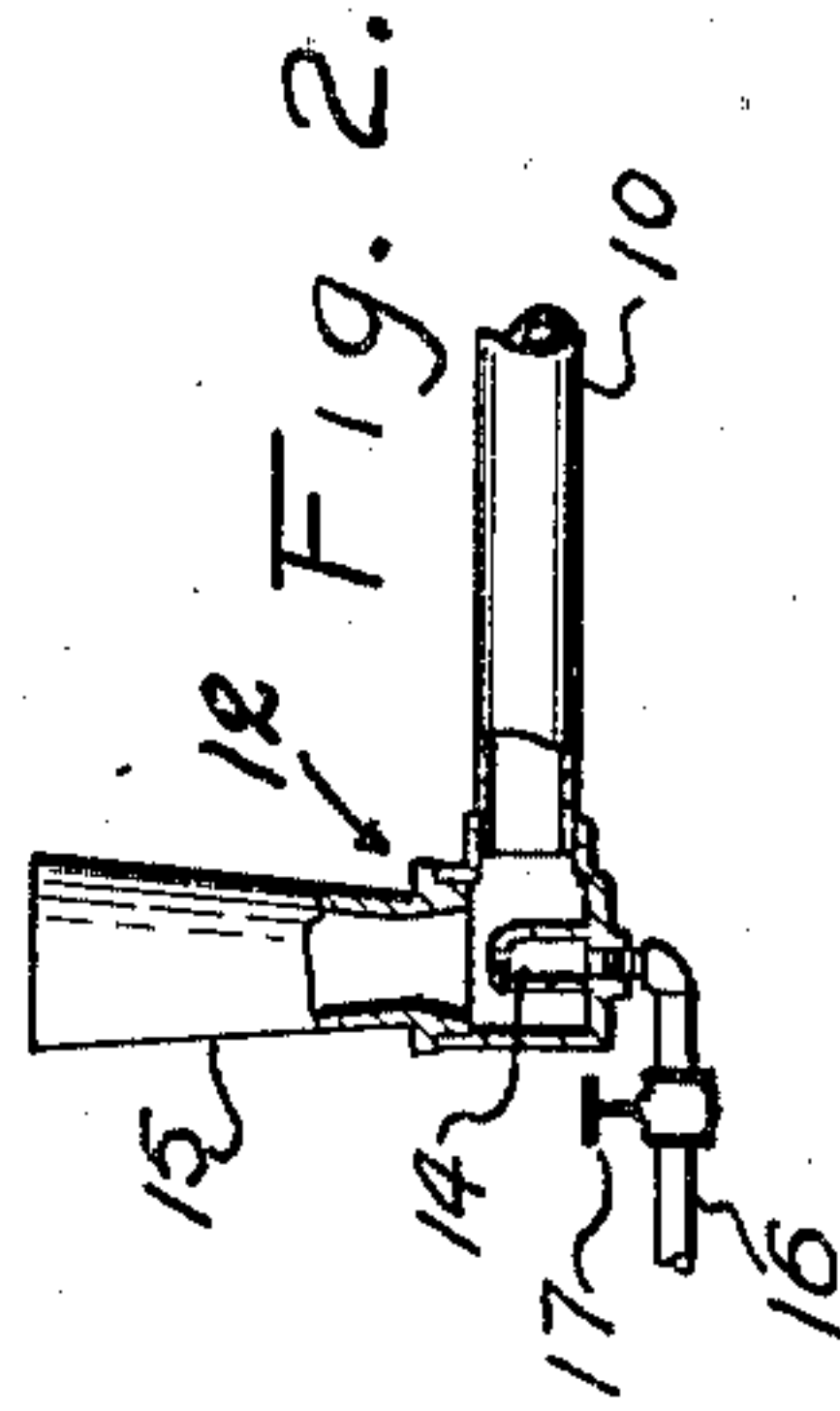


Fig. 2.

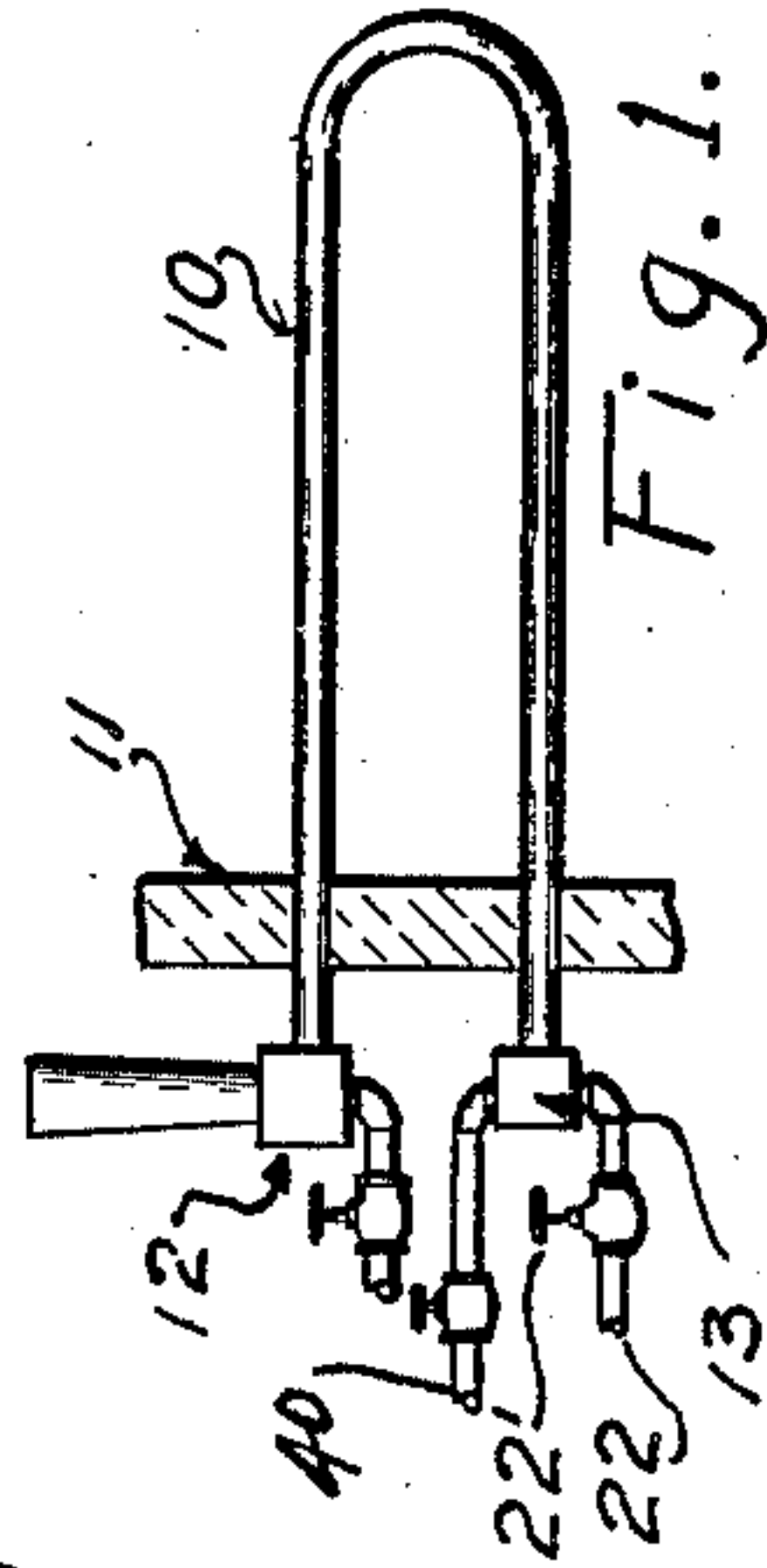


Fig. 1.

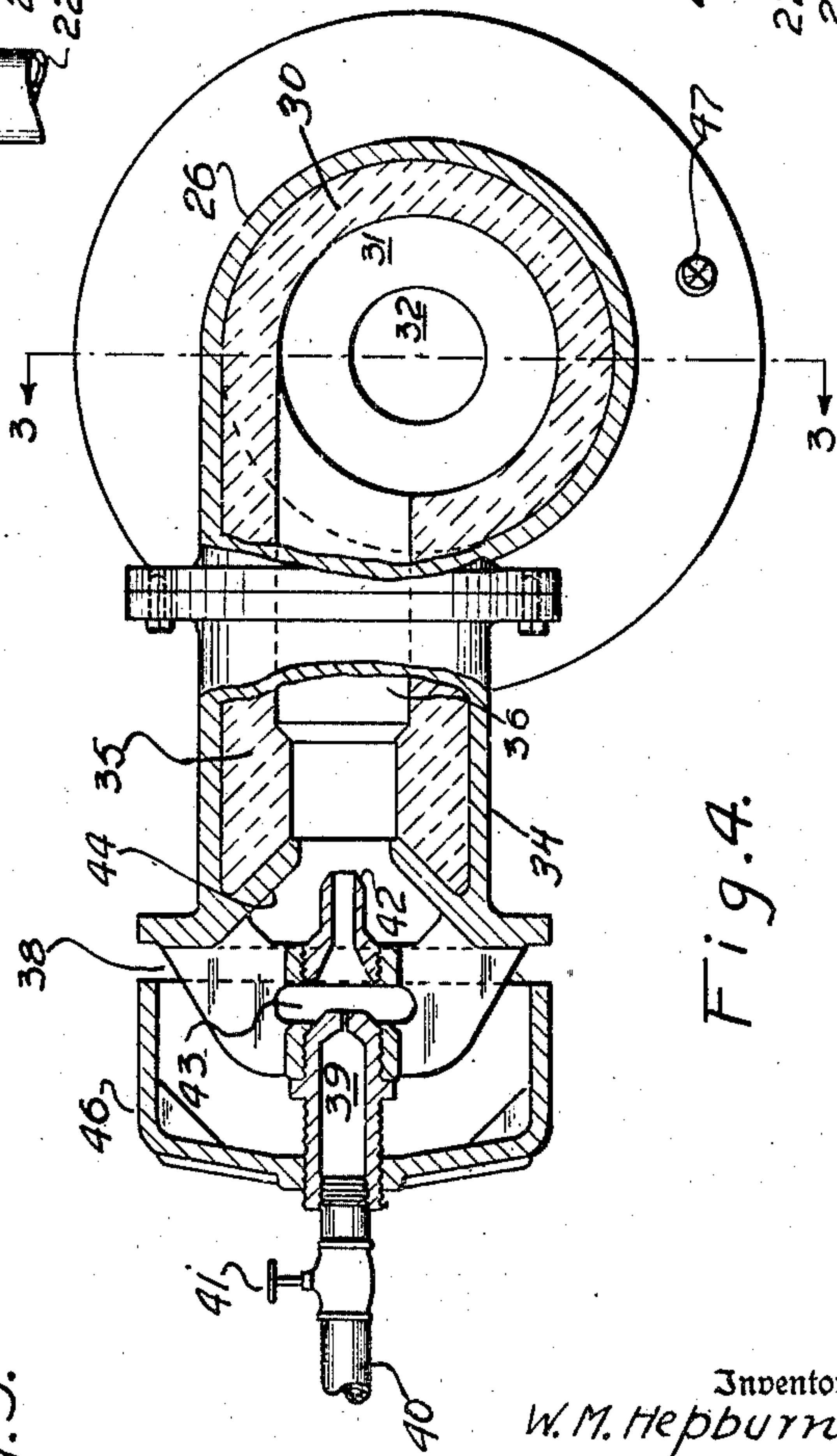


Fig. 4.

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## UNITED STATES PATENT OFFICE

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## HEATING APPARATUS

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10 Claims. (Cl. 158—7)

This invention relates to improvements in ways and means for producing heat in a relatively long radiator tube adapted to be arranged in a heating chamber for the purpose of serving as a heating element therein.

Referring to the accompanying drawing wherein the preferred embodiment of the invention is shown,—

Fig. 1 is a small scale view illustrative of the application of the present invention;

Fig. 2 is a fragmentary sectional view of a part shown in Fig. 1;

Fig. 3 is a greatly enlarged sectional view of another part shown in Fig. 1, the view being taken on line 3—3 of Fig. 4;

Fig. 4 is a sectional view taken on line 4—4 of Fig. 3;

Fig. 5 is a cross section along line 5—5 of Fig. 4.

The radiator tube to be fired is indicated at 10 and for simplicity of illustration has been shown as of hairpin type (in Fig. 1) with the free ends of the tube extending through a wall 11 of the heating chamber wherein the tube is positioned.

The device 12 associated with one end of the tube 10 is a suction producing device which for illustrative purposes has been shown as consisting of a jet orifice nozzle 14 set to discharge into an eductor tube 15 which forms in effect an extension of the exhaust end of the said tube. A pipe 16 having an ordinary shut-off valve 17 supplies fluid under pressure to the nozzle 14. As will more fully appear hereinafter, the primary purpose of the device 12 is to draw combustion supporting air into the other end of the tube 10.

The device 13 associated with the other end of the tube 10 embodies the present invention and briefly stated comprises means for introducing gaseous fuel into the tube and means for continuously insuring ignition of the fuel upon its entry into said tube.

The fuel which is to be burned in the radiator tube 10 is introduced into the same by a plurality of circumferentially spaced fuel tubes 19 leading from an annular gas supply chamber 20 in front of the mouth 21 of the radiator tube, the tubes 19 being of sufficient length to extend a substantial distance into said mouth. Fuel gas is supplied to the chamber 20 by a supply pipe 22 provided with a flow regulating valve 22' (see Fig. 1). The chamber 20 is concentrically supported with respect to said mouth 21 by a plurality of circumferentially spaced spacer fingers

23 which extend from a wall of said chamber to a ring 24 which slips over and is secured to a circumferential ledge 25 at the outer end of said mouth 21.

The chamber 20 is conveniently formed as part of a metal drum 26 which at one end converges inwardly as indicated at 27. Extending from and forming in effect an extension of the converging part 27 is a tube 28 which projects a substantial distance into the mouth 21 of the radiator tube 10, it being noted that the diameter of the tube 28 is very materially less than that of the radiator tube. The fuel tubes 19 preferably terminate short of the discharge end of the tube 28 and are shown as converging inwardly with respect to the latter, primarily because of the fact that the diameter of the annular gas chamber 20 is such as to require that arrangement when the tubes 19 are straight. However, insofar as the present invention is concerned, the tubes 19 might well be angled between their ends so as to make their respective discharge ends extend in parallelism with the tube 28. The tube 28 is shown as apertured between its ends as indicated at 29 for reasons presently appearing.

The drum 26 serves as a casing for a refractory body 30 through which extends a passage which intermediate its ends is enlarged as indicated at 31 to form in effect a chamber. That part 32 of said passage which leads to the tube 28 may be termed a throat; the other part 33 communicates with the atmosphere for reasons presently appearing.

Secured to and extending laterally away from the drum 26 is a tubular body 34 which serves as a casing for a refractory body 35 having an axial tunnel 36 which at one end opens into the aforesaid chamber 31 at one side of the axis of the latter as indicated at 37 and which at its other end is open to the atmosphere by way of a flaring mouth 44 formed as part of the body 34.

Supported by circumferentially spaced webs 38 integral with the body 34 at the front end thereof is a fuel discharge noggle 39 to which fuel is delivered by a fuel supply pipe 40 provided with an ordinary hand valve 41. Also supported by the webs 38 is a relatively short mixing tube 42 having a flaring mouth. The nozzle 39 and the mixing tube 42 are separated from each other by a gap 43 to which atmospheric air has access. The jet of fuel gas issuing from the nozzle 39 entrains some air as it flows into the mixing tube 42 and the mixture issuing from the latter entrains the balance of the air required for complete combustion of the fuel. If desired there



may be adjustably mounted on the body of the nozzle 39 a bell type damper 46 for restricting the free flow of air to the mixing apparatus in front of the tunnel 36.

5 Combustion of the fuel issuing from the nozzle 39 occurs in the tunnel 36 and the hot gases thus produced serve to ignite the fuel issuing from the fuel tubes 19. The burner which comprises the tunnel 36 therefor constitutes a pilot for igniting  
10 the fuel issuing from the tubes 19. Bearing in mind that the suction producing device 12 at the exhaust end of the radiator tube 10 produces a pull or suction effect at the intake end of said tube, it will be readily appreciated that the gases  
15 supplied to the chamber 31 will flow toward the region of low pressure, that is to say, toward the intake end of the radiator tube by way of the throat 32 and tube 28 rather than out to the atmosphere through the passage 33. Although the  
20 apparatus would function more or less efficiently even if there were no passage 33 in open communication with the atmosphere, or if the outer end of the passage were closed by a damper (not shown) nevertheless the advantages of such a passage are  
25 briefly as follows, namely, it serves as a lighting hole through which a flare may be inserted for initially igniting the fuel flowed into the combustion tunnel 36 from the fuel nozzle 39; as an inspection hole for observing whether the fuel  
30 flowing from the fuel tubes 19 is burning properly, and most important of all it serves as a means for preventing pulsation coming from the radiator tube 10 from blowing out the flame in the combustion tunnel 36.

35 By arranging the tunnel 36 to discharge tangentially into the chamber 31, the gases issuing from the tunnel spin around in said chamber with the result that pulsations from the radiator tube 10 cannot readily blow out the flame of the fuel  
40 issuing from the nozzle 39. The radial holes 29 in the tube 28 may be considered as breather holes which materially dampen the effect of said pulsations on the burner firing into the chamber 31.

In some cases, it may be desirable to introduce a small stream of fuel gas into the tube 28 in order to extend the flame issuing therefrom and to this end there is provided a small feed pipe 46 leading from the gas chamber 20 and projecting into the tube through one of the holes 29 in said  
50 tube 28, the flow of gas through the feed pipe being controlled by any conveniently located valve 47.

What is claimed is:

55 1. In combination, means for simultaneously flowing a stream of fuel and a stream of air into a confined space which is subject to draft, apparatus for maintaining ignition of said fuel irrespective of pulsations in said space comprising  
60 an open ended tube having its discharge end in the path of flow of fuel into said space, and a pressure burner firing tangentially into the tube intermediate the ends thereof whereby the gases spiral around in the tube before emerging from said discharge end.

65 2. In combination, means for simultaneously flowing a stream of fuel and a stream of air into a confined space which is subject to draft, apparatus for maintaining ignition of said fuel irrespective of pulsations in said space comprising  
70 an open ended tubular body having a discharge end in the path of flow of fuel into said space, said body having an enlarged chamber intermediate its ends, and a burner firing tangentially into said  
75 chamber whereby the gases spiral around in the

chamber before emerging from the discharge end of said tubular body.

3. In combination, means for simultaneously flowing a stream of fuel and a stream of air into a confined space which is subject to draft, apparatus for maintaining ignition of said fuel irrespective of pulsations in said space comprising an open ended tube having its discharge end in the path of flow of fuel into said space, said tube having a tangential port intermediate its ends, and a pressure burner firing into said port whereby the gases spiral around in said tube before flowing from the discharge end thereof.

4. In combination, means for simultaneously flowing a stream of fuel and a stream of air into a confined space which is subject to draft, apparatus for maintaining ignition of said fuel irrespective of pulsations in said space comprising an open ended tube having its discharge end in the path of flow of fuel into said space, said tube having a side port intermediate the ends thereof and a plurality of apertures between said port and said discharge end, and a burner firing into said port whereby the gases spiral around in said tube before flowing from the discharge end thereof.

5. In combination, means for simultaneously flowing a stream of fuel and a stream of air into a confined space which is subject to draft, apparatus for maintaining ignition of said fuel irrespective of pulsations in said space comprising an open ended tube having its discharge end in the path of flow of fuel into said space, said tube having an enlarged chamber intermediate its ends, and a pressure burner firing into said chamber whereby the gases spiral around in said chamber before flowing from the discharge end of said tube, said confined space comprising a radiator tube having a suction producing device at its discharge end.

6. In combination, means for simultaneously flowing a stream of fuel and a stream of air into a confined space which is subject to draft, apparatus for maintaining ignition of said fuel irrespective of pulsations in said space comprising means forming a passage having a side opening and having a discharge end in the path of flow of fuel into said space, and a burner firing into said side opening whereby the gases spiral around in said passage before emerging from the discharge end thereof, said confined space comprising a radiator tube having a suction producing device at its discharge end.

7. In combination, means for simultaneously flowing a stream of fuel and a stream of air into a confined space which is subject to draft, apparatus for maintaining ignition of said fuel irrespective of pulsations in said space comprising means forming a passage having a discharge end in the path of flow of fuel into said space and having an enlarged chamber portion remote from said discharge end, and a burner firing tangentially into said chamber whereby the gases spiral around in the chamber before emerging from the discharge end of said passage.

8. A burner apparatus comprising in combination a metallic drum, an annular fuel supply chamber intermediate the ends of said drum, a refractory lining within said drum and forming a flow passage therein, a tubular body carried by and forming an extension of said drum, a plurality of tubes in communication with said fuel supply chamber and arranged to discharge adjacent the discharge end of said body, and a pilot burner discharging into said passage for supply-



ing high temperature gases to said body whereby to ignite the fuel flowing from said tubes.

5 9. A burner apparatus comprising in combination a metallic casing, an annular fuel supply chamber formed in the casing intermediate the ends thereof, a refractory lining within said casing and forming a passage therein, a tubular extension at one end of said passage and forming a continuation thereof, said passage having an enlarged portion remote from said extension, a fuel supply tube in communication with said annular chamber and arranged to discharge adjacent the discharge end of said extension, and a pilot burner discharging its gases into the enlarged portion of said passage whereby to ignite the fuel flowing from said extension.

10. In apparatus for producing delayed combustion in a heat radiating tube which is subject to draft, the combination of a structure forming a combustion chamber outside of said tube, means for discharging a preformed mixture of air and fuel into said chamber, a hot gas conduit leading from said chamber into the intake end of said tube in radially spaced relation whereby to form an annular air passage between said tube and conduit, a source of fuel supply, and means for conducting said fuel from said source to a point in said tube between the walls of the latter and said conduit.

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