Dec. 30, 1947. H. J. DE N. McCOLLUM 2,433,618

FLUID FUEL INTERNAL-COMBUSTION AIR HEATER

Filed Feb. 25, 1943 2 Sheets-Sheet 1

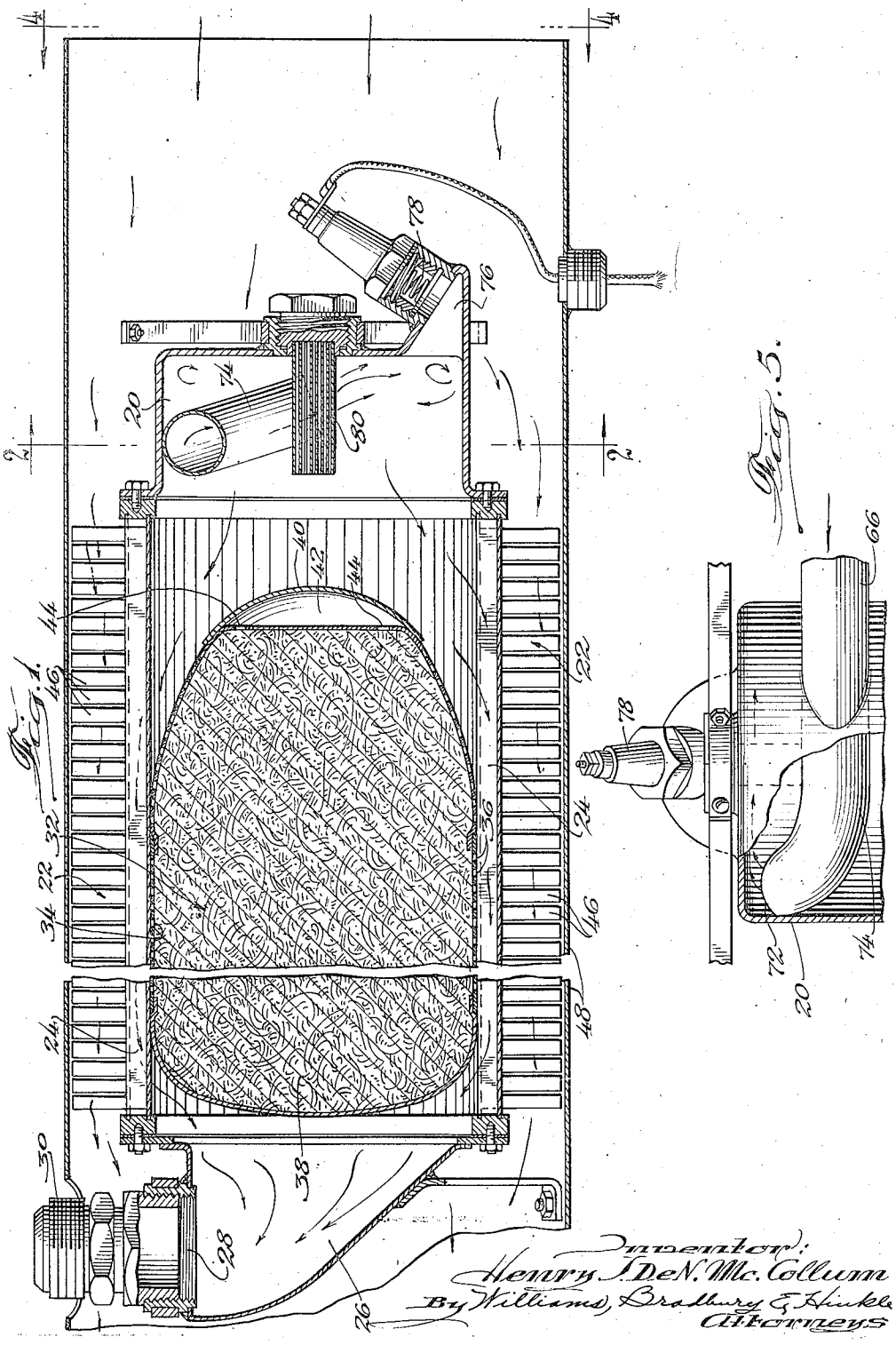

Fig. 1.

Fig. 5.

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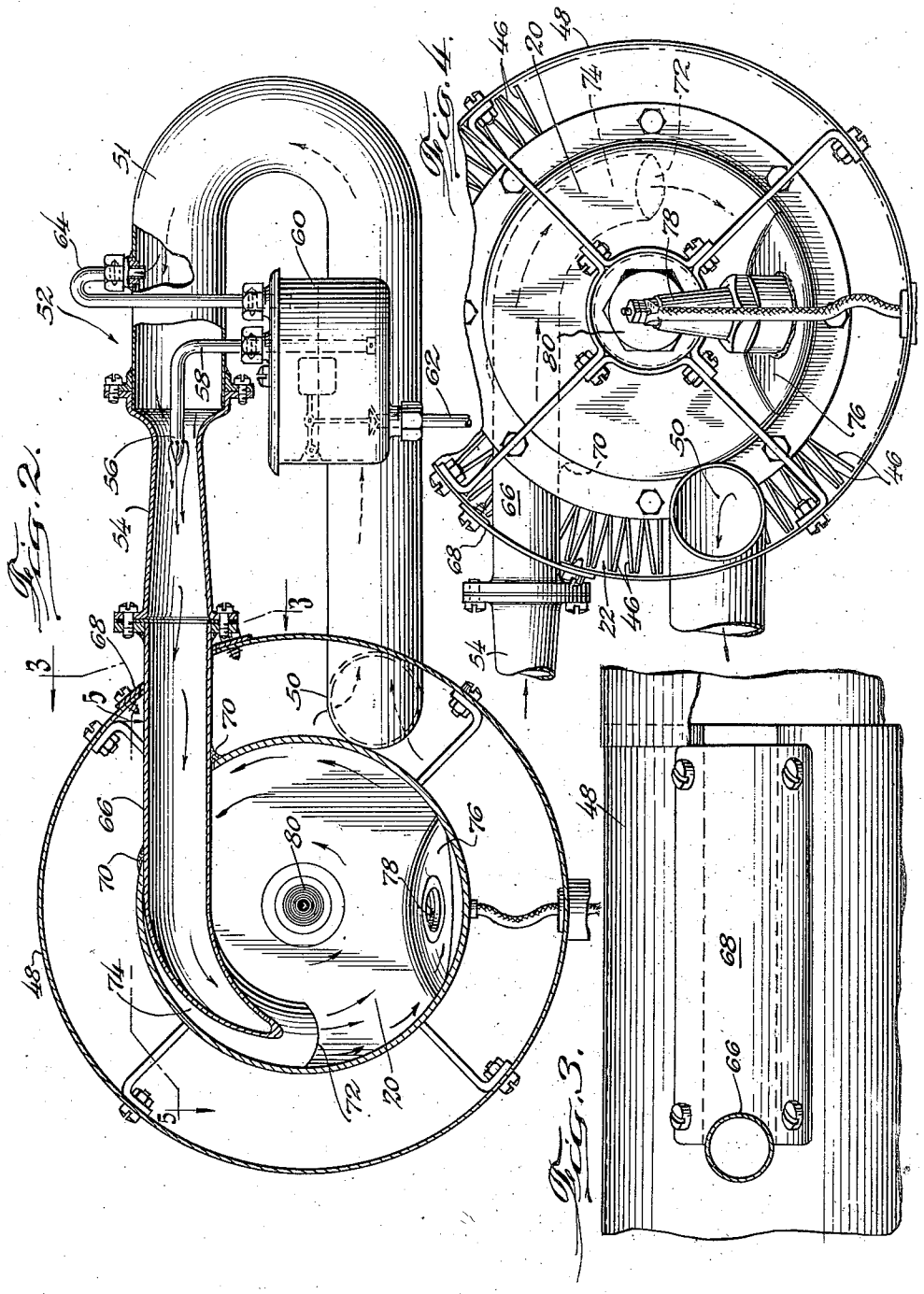

Fig. 2.

Fig. 4.

Fig. 3.

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UNITED STATES PATENT OFFICE

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FLUID FUEL INTERNAL-COMBUSTION AIR HEATER

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Application February 25, 1943, Serial No. 477,080

1 Claim. (Cl. 158—28)

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My invention pertains to heaters and more particularly to heaters of the internal combustion type.

An object of my invention is to provide an internal combustion type of heater so constructed that the combustion of the combusible mixture in the combustion chamber can not flash back into the induction tube through which this mixture is supplied to the combustion chamber.

Another object of my invention is to provide a heater of the internal combustion type wherein the combustion tube leading to the combustion chamber is so constructed that it provides a smooth, rapid flow of combustible mixture to the combustion chamber, this flow being free from eddy currents and dead pockets and being at a rate greater than the rate of flame propagation whereby combustion in the induction tube is prevented.

Another object of my invention is to provide a heater of the internal combustion type wherein the combustible mixture is delivered to the combustion chamber in such manner as to form a continuous ring of flame, thereby permitting complete combustion of the fuel mixture in a short, compact combustion chamber.

Another object of my invention is to provide a heater of the internal combustion type which will provide any desired degree of preheating of the combustible mixture and which is equally adapted for use with light and heavy fuel.

Another object of my invention is to provide a heater of the internal combustion type which is light in weight, efficient, compact, inexpensive to manufacture, reliable, and capable of giving long and trouble-free service.

Other objects and advantages will become apparent as the description proceeds.

In the drawings:

Fig. 1 is a longitudinal, sectional view of a heater embodying one form of my invention;

Fig. 2 is a transverse, sectional view taken on the line 2—2 of Fig. 1;

Fig. 3 is a partial, sectional view taken on the irregular line 3—3 of Fig. 2;

Fig. 4 is an end view of the heater shown in Fig. 1 looking in the direction of the arrows 4—4 of Fig. 1; and

Fig. 5 is a partial, sectional view taken on the irregular line 5—5 of Fig. 2;

The heater shown in Figs. 1 to 5, inclusive, has a combustion chamber 20 attached to one end of a heat exchanger 22 which is illustrated as being of the type disclosed and claimed in my co-pending application, Serial No. 464,451, filed November 4, 1942, Patent No. 2,380,602. The heat exchanger 22 is of tubular shape and has longitudinally extending flues 24 through which the hot gases from the combustion chamber pass on their way to an outlet chamber 26. The outlet chamber 26 communicates with atmosphere through an outlet fitting 28 and any suitable exhaust pipe attached to the threaded end 30 of this fitting.

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A muffler 32 is located in the tubular heat exchanger 22 and comprises a sheet metal shell 34 having narrow slots 36 forming acoustic couplings between the flues 24 and the interior of the muffler shell whereby sound may pass into this shell and be absorbed by the sound absorbing material 38 contained therein. This sound absorbing material may be stainless steel wool or glass wool, or any other suitable sound absorbing material. The muffler 32 is provided with a nose 40 which aids in directing the hot products of combustion into the flues 24 and an empty acoustic chamber 42 is formed in this nose and communicates with the interior of the main portion of the muffler by way of openings 44.

As the hot gases from the combustion chamber travel lengthwise of the flues 24, these gases give up heat to the heat exchanger 22. This heat exchanger has fins 46 projecting into the stream of ventilating air which is directed over the fins by a casing 48 surrounding the combustion chamber 20 and heat exchanger 22. As this ventilating air passes over the fins 46, it is heated and the heated air passes from the lefthand end of the casing 48 into a space to be heated or into a duct system having selected outlets in such space or spaces.

Air for ventilating purposes and for supporting combustion in the combustion chamber 20 is supplied to a righthand end of the casing 48 by a ram, blower or any other suitable means. Most of this air passes over the finned heat exchanger 22 and provides heated ventilating air for the space or spaces to be heated. Part of the air supplied to the casing 48, however, enters the inlet end 50 (Figs. 2 and 4) of a pipe 51 leading to a carburetor indicated generally by reference character 52. This carburetor is provided with the usual Venturi tube 54 having a restricted throat in which the fuel jet 56 is located. This fuel jet has a pipe 58 which extends down into and near the bottom of a conventional float bowl 60. A pipe 62 connects the float bowl with any suitable source of fuel.

The upper part of the float bowl is connected by pipe 64 with the pipe 51 so that the pressure

differential between the pipe 51 and throat of the Venturi tube is available to lift fuel from the float bowl 60 to the jet 56 and discharge it through the openings in this jet into the air flowing through the throat of the Venturi tube 54. The mixture of fuel and air formed in the Venturi tube 54 is delivered to the induction tube 66 which passes through the casing 48 and into the combustion chamber 20. A plate 68 is removably attached to the casing 48, partially to cover an opening in this casing which permits insertion and removal of the induction tube 66. Where this tube passes through a wall of the combustion chamber 20, the tube is preferably welded or soldered to the combustion chamber wall, as indicated at 70, to form a gas-tight joint therebetween.

The induction tube 66 has a smooth interior which is free from obstructions or pockets and which permits a smooth flow of the combustible mixture therethrough. This induction tube is of such diameter that the rate of flow of the combustible mixture therethrough is faster than the rate of flame propagation so that in normal operation of the heater no combustion takes place in the induction tube. If, for any reason, the rate of flow of combustible mixture in the induction tube should be reduced temporarily so that combustion would take place in this tube, as soon as the normal rate of flow of the combustible mixture is restored, the burning gases will be driven from this tube into the combustion chamber and continuance of combustion in the induction tube will be avoided. The smooth, uniform diameter of this tube is an important factor in this regard, since it prevents the formation of eddy currents or pockets where combustion could continue because the rate of flow in these eddy currents would be less than the rate of flame propagation.

In the normal operation of the heater, the combustible mixture does not burn until after it has moved an appreciable distance beyond the discharge end 72 of the induction tube. The part 74 of this induction tube which lies within the combustion chamber 20 forms a means for preheating the mixture of fuel and air to any desired degree before this mixture is ignited. In Fig. 2, the preheating portion 74 of the induction tube is shown as extending through an arc of somewhat more than 90° which affords ample preheating where the heater is operated with gasoline or other relatively light fuels.

Because of the curvature of the portion 74 of the induction tube, the mixture delivered to the combustion chamber whirls about the longitudinal axis of this chamber, as clearly indicated by the arrows in Fig. 2. The curved portion 74 of the induction tube, however, does not necessarily lie in a plane perpendicular to the axis of the combustion chamber and in the particular embodiment shown the end portion of this tube is inclined, as shown in Fig. 1, to direct the combustible mixture toward a pocket 76 formed at one end of the combustion chamber. The electrical igniter 78 communicates directly with this pocket which receives fresh combustible mixture from the induction tube, but slows down the rate of travel of this mixture to such an extent that it may be easily ignited.

The electrical igniter 78 may operate continuously. However, in heaters of this type it is usual to connect this igniter with its source of current through a thermostatic switch which cuts out the igniter after the heater has attained normal operating temperature and where this is done it is common to use a re-igniter to maintain combustion thereafter. I have indicated such a re-igniter by reference character 80, although in heaters embodying my invention such a re-igniter is not essential since the ring of flame in the combustion chamber is sufficient in and of itself to maintain combustion after the electrical igniter 78 has cut out. This ring of flame starts a short distance beyond the end 80 of the induction tube and continues around the inner surface of the annular wall of the combustion chamber and overlaps this end 80 to form an unbroken ring of fire which ignites the mixture flowing from the end of the induction tube.

The whirling motion of the mixture entering the combustion chamber and the inclination of the outer end of the induction tube toward the rear wall of this chamber insure complete combustion of the mixture within a very short combustion chamber. This short combustion chamber reduces the total length of the heater and also reduces the weight of the heater. Since the walls of the combustion chamber are directly exposed to the ventilating air, all heat which passes into these walls is transferred to the ventilating air and is thus efficiently used and does not represent a loss.

The induction tube has a smooth inner surface which eliminates eddy currents of small velocity which would support combustion in the normal operation of the heater. The diameter of the induction tube is so selected that the rate of flow of combustible mixture therethrough is faster than the rate of flame propagation, so that no combustion takes place in this tube during normal heater operation. If, for any reason, the rate of flow of the combustible mixture in the induction tube should be temporarily reduced sufficiently to permit combustion to take place in this tube, all burning gases will be immediately discharged from the induction tube as soon as normal flow of combustible mixture is restored.

That part of the induction tube lying within the combustion chamber may be made of any length to give the desired preheating and is preferably of such length that the mixture entering the combustion chamber is preheated to such a degree that it will burn cleanly and quickly as soon as it is ignited. This feature, together with the circular motion of the combustible mixture in the combustion chamber and the resultant ring of flame, permit complete and efficient combustion in a combustion chamber of short length and without increasing the diameter of the combustion chamber over that commonly used in such heaters.

Because of the provisions for obtaining any desired amount of preheating of the combustible mixture, my novel heater is equally adapted for use with kerosene, fuel oils and other relatively heavy fuels, as well as gasoline and other light fuels.

It is to be understood that my invention is not limited to the details shown and described, but may assume numerous other forms and that the scope of my invention is defined in the following claim.

I claim:

A heater of the class described having heat exchange means, comprising means forming a combustion chamber, means connecting said combustion chamber with said heat exchange means for the delivery of hot gases thereto, means including an induction tube of substantially uniform

diameter for supplying a combustible mixture to said chamber, said chamber having a cylindrical wall merging with an end wall to form a pocket, said induction tube having a portion extending into said chamber and curved about the axis thereof, said curved portion being inclined with respect to said axis and having an outlet end directed toward said pocket, and an electrical igniter for igniting combustible mixture in said pocket.

HENRY J. DE N. McCOLLUM.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,017,180	Shearman et al.	Feb. 13, 1912
2,247,977	Uschold et al.	July 1, 1941
1,670,819	Morris et al.	May 22, 1928
1,691,541	Carlson et al.	Nov. 13, 1928
1,936,623	Frentzel	Nov. 28, 1933
1,357,598	Thompson	Nov. 2, 1920
2,215,983	Smith	Sept. 24, 1940
1,808,120	Runkwitz	June 2, 1931
1,394,894	Good	Oct. 25, 1921