March 11, 1947. H. J. DE N. McCOLLUM 2,417,315

CAST INTERNAL COMBUSTION HEATER FOR HEATING AIR

Filed July 29, 1942 3 Sheets-Sheet 1

Fig. 1.

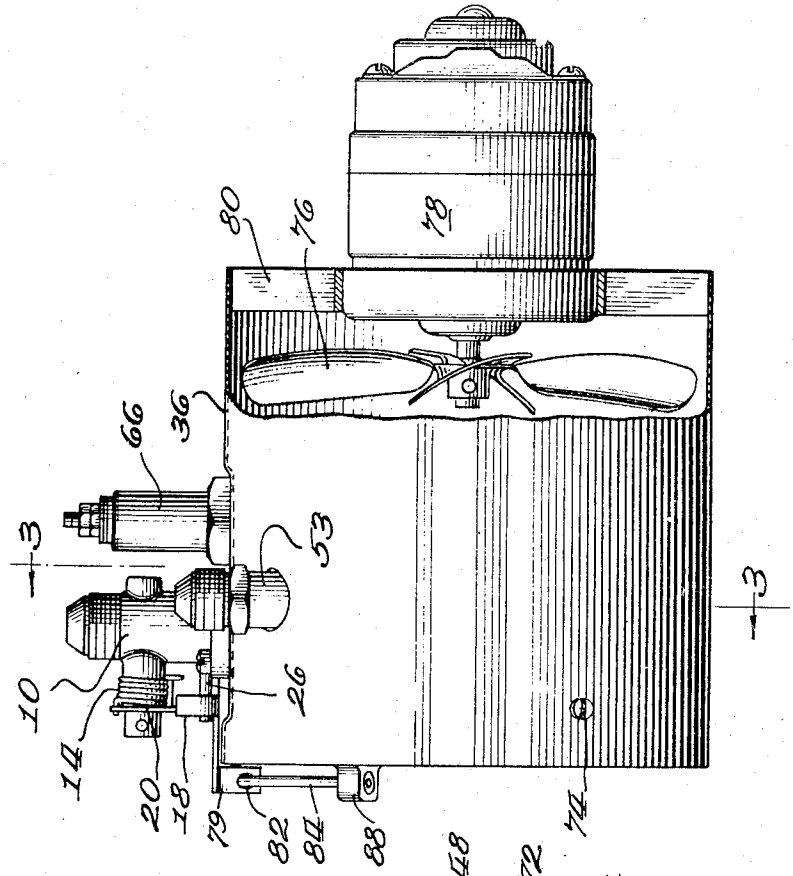
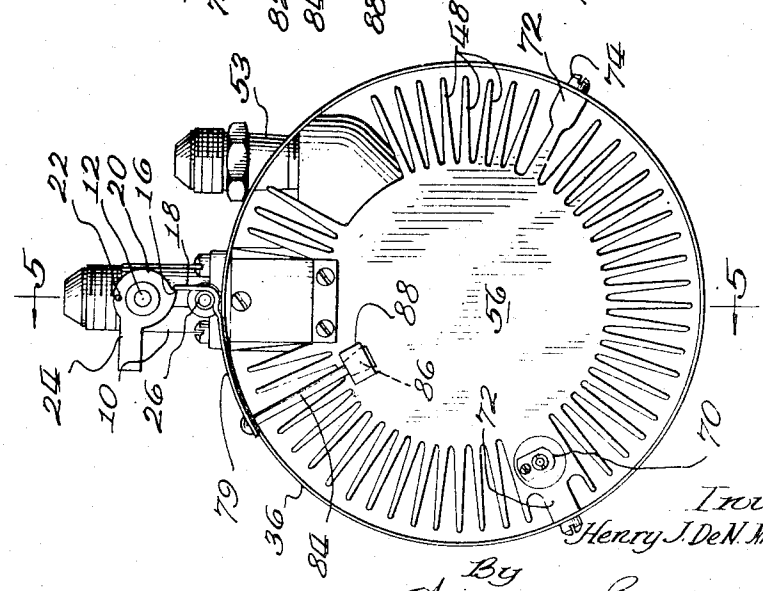


Fig. 2.



Inventor:
Henry J. De N. McCollum
By
Williams, Bradbury & Hubbell
Attys

March 11, 1947. H. J. DE N. McCOLLUM 2,417,315

CAST INTERNAL COMBUSTION HEATER FOR HEATING AIR

Filed July 29, 1942 3 Sheets-Sheet 2

Fig. 3.

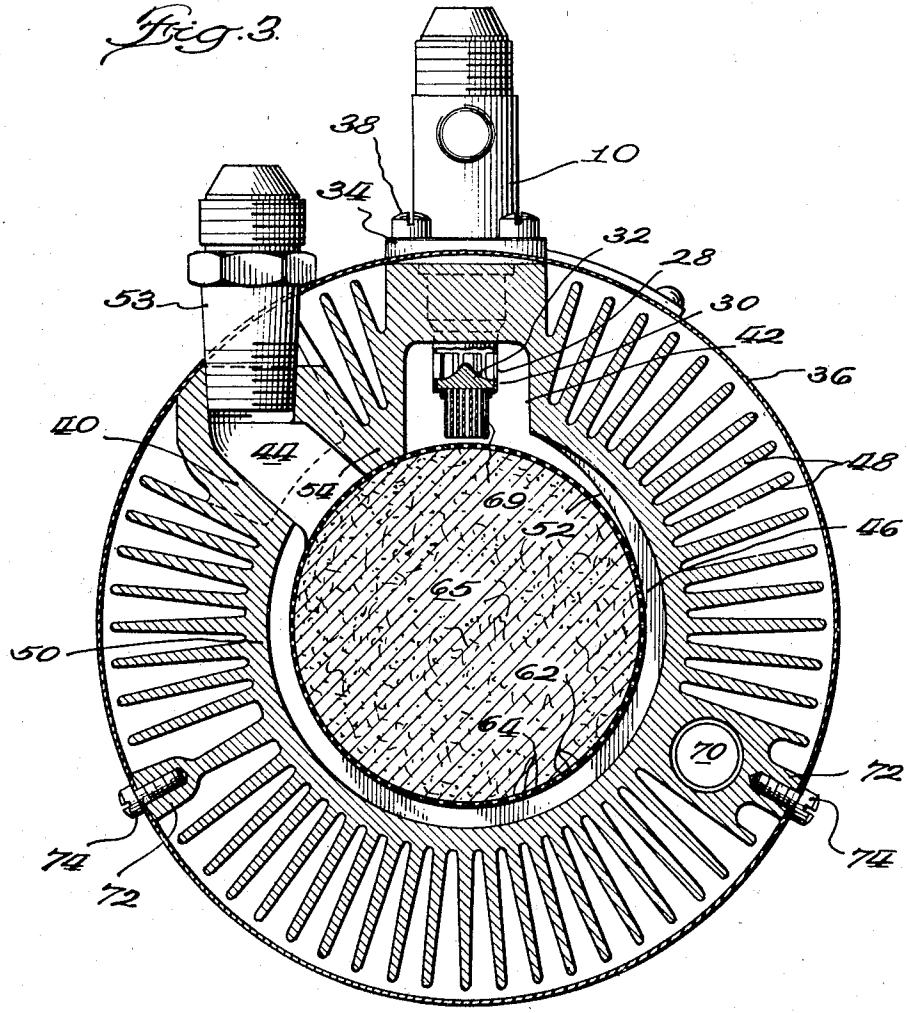
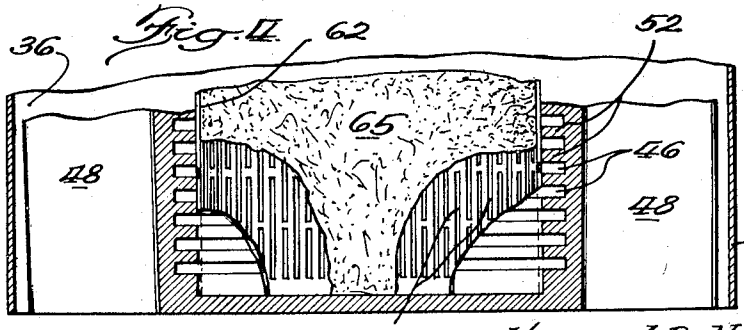


Fig. 4.



Inventor
Henry J. DeN. McCollum
By Williams, Bradbury & Hinkle
Attys

March 11, 1947. H. J. DE N. McCOLLUM 2,417,315

CAST INTERNAL COMBUSTION HEATER FOR HEATING AIR

Filed July 29, 1942 3 Sheets-Sheet 3

Fig. 5.

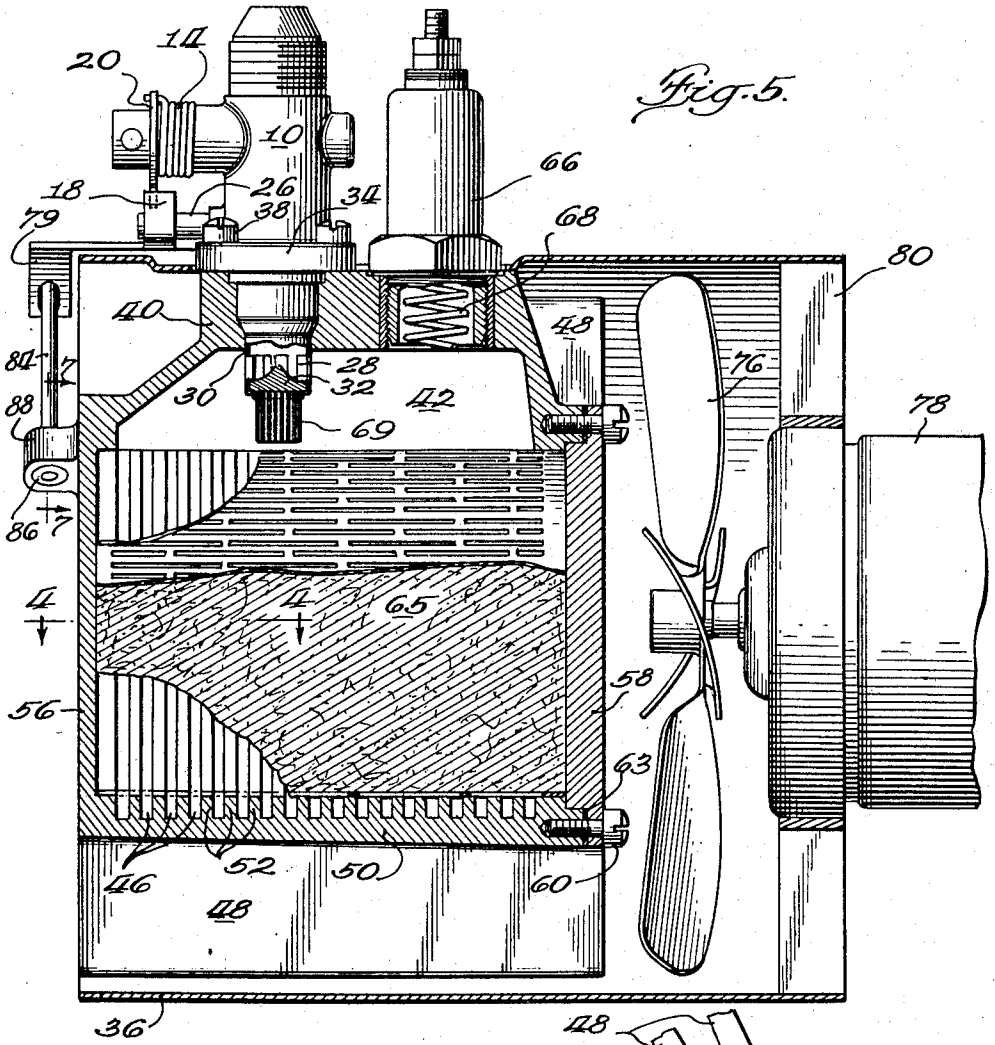


Fig. 6.

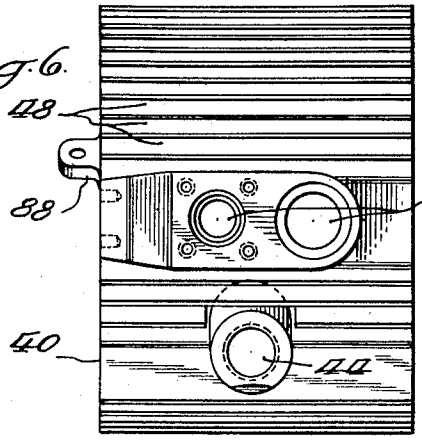
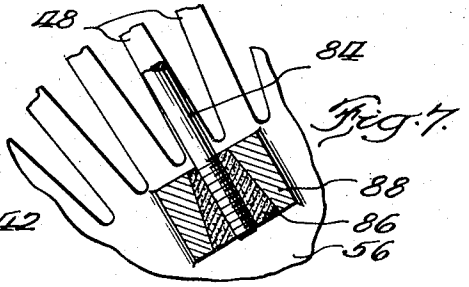


Fig. 7.



Inventor:
Henry J. De N. McCollum
By
Williams, Bradbury & Hinkle
Attys.

Patented Mar. 11, 1947

2,417,315

UNITED STATES PATENT OFFICE

2,417,315

CAST INTERNAL-COMBUSTION HEATER FOR HEATING AIR

Henry J. De N. McCollum, Chicago, Ill.; Thelma McCollum, executrix of said Henry J. De N. McCollum, deceased, assignor to Stewart-Warner Corporation, Chicago, Ill., a corporation of Virginia

Application July 29, 1942, Serial No. 452,707

6 Claims. (Cl. 126—110)

1

The present invention relates to heaters of the internal combustion type, and more particularly to a heater of this type well adapted, because of its high heat output considering its size and weight, to use in aircraft and other vehicles where the weight and size of equipment are primary considerations.

One of the objects of the present invention is to provide an improved heater which may be constructed as a small integral unit at comparatively low cost.

Yet another object of the present invention is to provide a novel internal combustion heater in which the principal structural element can be formed as a single casting.

Still another object of the present invention is to provide a novel, small, inexpensive internal combustion heater having improved safety mechanism to prevent overheating.

Other objects and advantages will become apparent from the following description of a preferred embodiment of my invention.

In the drawings, in which similar characters of reference refer to similar parts throughout the several views:

Fig. 1 is a side elevation of a heater embodying the present invention, with a portion of the housing thereof broken away to illustrate the position of an air circulating fan;

Fig. 2 is a left end elevation of the heater shown in Fig. 1;

Fig. 3 is a vertical, transverse sectional view which may be considered as taken substantially along the line 3—3 of Fig. 1 in the direction of the arrows;

Fig. 4 is a horizontal, medial sectional view through the outlet portion of the heater and may be considered as taken along the line 4—4 of Fig. 5 looking downwardly, as indicated by the arrows;

Fig. 5 is a vertical, longitudinal sectional view taken in the direction of the arrows along the line 5—5 of Fig. 2;

Fig. 6 is a plan view of a casting forming one of the principal elements of the heater of the present invention; and

Fig. 7 is a fractional, detail sectional view drawn to larger scale and may be considered as taken along the line 7—7 of Fig. 5 in the direction of the arrows.

2

The heater of the present invention includes an inlet fitting 10 threaded to receive a connection leading to a source of combustible mixture. This fitting includes a butterfly valve, not shown, but which is mounted upon a transversely extending rotatable shaft 12. The shaft and valve are biased by a coil spring 14 to revolve toward closed position, and are normally held in open position by a latch 16 which impinges against a detent 18, to be described more fully presently. The latch 16 is formed in the edge of a disc 20 secured to the butterfly valve shaft 12, this disc also having a small hole 22 through which one end of the coil spring 14 is hooked, the other end of the spring being held in fixed position by any suitable means. At another portion, the disc also has an outwardly extending lug 24 which impinges against a pin 26 when the valve shaft 12 is revolved approximately 90° from its open position.

With this arrangement, the normal tendency of the spring 14 is to rotate the valve shaft 12 into a position with the stop lug 24 against the pin 26. In such position the butterfly valve extends across the bore through the fitting 10, thus substantially preventing the flow of combustible mixture therethrough. In order to open the valve, therefore, it may be manually rotated into the position best shown in Fig. 2, with the latch 16 hooked behind the detent 18, the parts being adapted to yield resiliently so as to permit the detent to snap into engagement with the latch. As long as this detent remains in place, therefore, the butterfly valve will extend vertically within the bore through the inlet fitting 10, thus permitting the flow of combustible mixture therethrough.

The lower portion of the fitting 10 is reduced in size, and at its lower end is provided with a plurality of radial ports 28 formed by striking vanes outwardly from the cylindrical member 30, the lower end of this cylindrical member being closed by a generally conical plug 32. Combustible mixture moving downwardly through the fitting 10, therefore, will strike the conical plug 32 and will flow outwardly through the radial ports 28. Inasmuch as the vanes are struck outwardly at an angle, the combustible mixture will leave the fitting 10 with a swirling motion.

At a point somewhat above the radial ports

28, the fitting 10 has a flange 34, which is drilled at four points to permit the passage therethrough of screws 38, which are threaded into the upper portion of a generally cylindrical, finned casting 40 enclosed within a cylindrical shell 36, said fitting 10 being thus held in substantially radial position in an opening at the top of said casting 40. The casting 40 provides, when assembled with other elements, a combustion chamber 42, an exhaust outlet passage 44 separated from the chamber 42 by an inwardly extending rib 54, a plurality of circular parallel passages 46 in the form of grooves between ribs 52 for conveying the hot products of combustion from the combustion chamber 42 in clockwise direction in Fig. 3 to the exhaust passage 44, and a plurality of outwardly directed heat exchange fins 48 which interchange the heat from the hot products of combustion to the air to be heated.

In general, the casting 40 comprises a cylindrical central section 50, the upper portion of the wall of which is offset outwardly to provide the longitudinally extending combustion chamber 42 and the exhaust chamber 44.

The ribs 52 are closely spaced and extend circumferentially from a position closely adjacent the combustion chamber 42 around the inner circumference of the casting to an outlet passage 44, the wall portion of the casting forming the outlet passage being threaded to receive a fitting 53. This outlet passage 44 is closely adjacent to the combustion chamber 42, communication directly between these two openings in the inner circumference being blocked by said inwardly extending rib 54 of the casting which has its inner face the same radial distance from the center line of the casting as the inner edges of the ribs 52. The exhaust passage 44 extends longitudinally and is substantially coextensive in length with the combustion chamber 42, and both of these chambers are coextensive longitudinally with the circumferentially arranged passages 46 all of which communicate at both ends with the chambers 42 and 44.

The generally cylindrical opening or recess in the casting 40 is closed at one end by an endpiece 56 formed as a portion of the casting. The other end of the opening is closed by a cover 58 and gasket 63 secured in place by screws 60 so as to hold a cylindrical sleeve 62 in position therein. This sleeve has approximately the same diameter as the internal dimension of the casting and, therefore, serves as a partial closure for the inner faces of the passages 46. It also, acting in conjunction with the inwardly extending rib 54, serves as a partial closure for the combustion chamber 42 from the outlet passage 44 excepting by way of the passages 46.

The sleeve 62 is perforated by a multiplicity of longitudinally extending slots 64 arranged in rows, the slots in adjacent rows being staggered, as is best illustrated in Figs. 4 and 5. These slots extend crosswise of the passages 46 so that the intersecting passages and slots form a multiplicity of small, generally rectangular openings communicating between the passages 46 and the interior of the sleeve. The interior of the sleeve is packed with stainless steel wool 65, or other acoustic damping material, so that the structure acts as a muffler—that is, it damps out the noise accompanying operation and smooths out pulsations which otherwise might produce the effect known as "motor boating."

The combustible mixture flowing into the combustion chamber 42 is ignited by an igniter plug 66 of the hot wire type, threaded into an opening formed in the portion of the casting above the combustion chamber 42. The principal operating element of the igniter plug is a spirally wound coil 68, which, when electrically energized, is heated to a temperature sufficient to initiate the burning of the combustible mixture. After the heater warms up somewhat, the igniter can be deenergized inasmuch as a reigniter 69, formed of a loosely coiled sheet of Inconel or other heat and corrosion resistant metal, acts to reestablish combustion if combustion should for any reason fail. This reigniter is described in greater detail in my Patent No. 2,396,868, and for convenience, is secured to the lower end of the fitting 10 below the radial ports 28.

A thermostatic element 70, located in an opening in the end of the casing 40, acts as an overheat switch and operates a solenoid valve to shut off the flow of combustible mixture if the heater becomes abnormally hot. The solenoid valve is not shown, but is connected in the supply conduit connected to the inlet fitting 10.

Substantially the entire circumference of the cylindrical portion 50 of the casting 40 is provided with the longitudinally extending fins 48, previously mentioned. At two points a pair of legs 72 extend outwardly from the central portion 50 and support the outer cylindrical shell 36, the shell being secured to these legs by screws 74. In general, the legs 72 are equally spaced circumferentially from each other and from the upper portion of the casting into which the inlet fitting 10 and igniter plug 66 are threaded. The shell 36 also rests against this upper portion, thus giving the shell three points of securement to the casting located in its interior, thus providing a rigid structure.

The forward or outlet end of the shell 36 at the left in Fig. 5 is approximately coextensive with the end of the casting 40, while at its rearward end the shell extends somewhat beyond the casting to provide space for a fan 76 driven by an electric motor 78 mounted upon a spider 80 secured to the shell 36. Thus, when the motor 78 is energized to rotate the fan 76, air is drawn inwardly around the motor and is passed forwardly between the fins 48, thereby providing a good interchange of heat from the combustion chamber and passages 46 to the air stream.

The previously mentioned latching detent 18 is formed from a piece of sheet metal 79 and extends downwardly from its position behind the latch 16, around the pin 26, and to the left, as seen in Fig. 2. A short distance from the pin, it is bent downwardly to form an abutment which rests against the side wall of the case. Shortly beyond this point, it extends outwardly beyond the outlet end of the case, from which point it extends farther to the left, and near its end is provided with a hole 82. A pin 84 extends radially inwardly through this hole and at its inner end is secured to a conical plug 86 of fusible metal wedged into a conical opening formed in a lug 88 projecting outwardly from the end of the casting 40. The metal from which the fusible plug 86 is made depends upon the operation characteristics of the particular heater. This metal should be so chosen that under normal conditions the heater never becomes sufficiently hot to melt this plug, but abnormal conditions, which may arise if, for instance, the fan 76 should stop and the overheat switch 70 fails to operate, will result in the plug 86 being melted before the

heater becomes dangerously hot. The fusible plug is, therefore, a safety provision in addition to that provided by the overheat switch 70.

Upon the melting of this plug, the inner end of the pin 84 is no longer restrained, and the lower end of the sheet metal member 79 flies outwardly under the influence of the spring 14 which rotates the valve in the inlet passage into closed position in the manner previously mentioned.

It will be seen that a heater constructed in the manner described and illustrated is extremely economical to manufacture, inasmuch as the single casting 40 provides the principal operating elements in conjunction with such accessories as the cylindrical perforated sleeve 62, the valve 10, the igniter 66, the fan and motor 76 and 78, and the extremely simple safety device comprised of the sheet metal member 79, the pin 84 and the fusible plug 86.

While I have shown and described a particular embodiment of my invention, it will be apparent to those skilled in the art that numerous modifications and variations may be made without departing from the underlying principles of the invention. I therefore desire, by the following claims, to include within the scope of my invention all such modifications and variations by which substantially the results thereof may be obtained by the use of substantially the same or equivalent means.

I claim:

1. In an internal combustion heater, a generally cylindrical casting, said casting having a longitudinally extending combustion chamber at one side and a longitudinally extending cylindrical recess intersecting said combustion chamber, said casting also providing a longitudinally extending outlet passage at one side adjacent said combustion chamber, said casting having a plurality of circumferential parallel grooves extending from said combustion chamber to said outlet passage and passing around the major portion of the circumference of said cylindrical recess, and a sleeve fitted into said cylindrical recess to close said grooves, thereby providing a plurality of circumferentially extending passages connecting said combustion chamber to said outlet passage.

2. In an internal combustion heater, a generally cylindrical casting, said casting having a longitudinally extending combustion chamber at one side and a longitudinally extending cylindrical recess intersecting said combustion chamber, said casting also providing a longitudinally extending outlet passage at one side adjacent said combustion chamber, said casting having a plurality of circumferential parallel grooves extending from said combustion chamber to said outlet passage and passing around the major portion of the circumference of said cylindrical recess, a sleeve fitted into said cylindrical recess to close said grooves, thereby providing a plurality of circumferentially extending passages connecting said combustion chamber to said outlet passage, said sleeve having a plurality of longitudinally extending slots in the side wall thereof, and a quantity of acoustic damping material located within said sleeve.

3. In an internal combustion heater, a generally cylindrical casting, said casting providing a longitudinally extending combustion chamber at one side and a longitudinally extending cylindrical recess intersecting said combustion chamber, said casting also providing a longitudinally extending outlet passage at one side adjacent said combustion chamber, said casting having a plurality of circumferential parallel grooves extending from said combustion chamber to said outlet passage and passing around the major portion of the circumference of said cylindrical recess, a sleeve fitted into said cylindrical recess to close said grooves, thereby providing a plurality of circumferentially extending passages, said sleeve having a plurality of slots in the side wall thereof extending transversely of said grooves, a quantity of acoustic silencing material located within said sleeve, an inlet fitting attached to said casting for conveying combustible mixture to said combustion chamber, thermostatic means for shutting off the flow of fuel to the heater when the casting becomes abnormally hot, and other thermostatic means including a fusible member for shutting off the flow of fuel through said fitting when the heater becomes dangerously hot.

4. In an internal combustion heater, a generally cylindrical casting, said casting providing a longitudinally extending combustion chamber at one side and a longitudinally extending cylindrical recess intersecting said combustion chamber, said casting also providing a longitudinally extending outlet passage at one side adjacent said combustion chamber, said casting having a plurality of circumferential parallel grooves extending from said combustion chamber to said outlet passage and passing around the major portion of the circumference of said cylindrical recess, a sleeve fitted into said cylindrical recess to close said grooves, thereby providing a plurality of circumferentially extending passages, a plurality of longitudinally extending heat exchange fins formed upon the outer surface of said casting, a shell enclosing said fins, and air circulating means to circulate air to be heated through said shell.

5. In an internal combustion heater, a generally cylindrical casting, said casting providing a longitudinally extending combustion chamber at one side and a longitudinally extending cylindrical recess intersecting said combustion chamber, said casting also providing a longitudinally extending outlet passage at one side adjacent said combustion chamber, said casting having a plurality of circumferential parallel grooves extending from said combustion chamber to said outlet passage and passing around the major portion of the circumference of said cylindrical recess, a sleeve fitted into said cylindrical recess to close said grooves, thereby providing a plurality of circumferentially extending passages, said sleeve having a plurality of slots in the side wall thereof extending transversely of said grooves, a quantity of acoustic silencing material located within said sleeve, a plurality of longitudinally extending heat exchange fins formed upon the outer surface of said casting, a shell enclosing said fins, and air circulating means to circulate air to be heated through said shell.

6. In an internal combustion heater, the combination of a casting having a generally cylindrical recess therein, a sleeve in said recess in spaced relation to the wall of the casting, a longitudinally extending rib interrupting the space between the casting and the sleeve at one side of said recess, said casting having a cavity substantially bounded at one side by said sleeve and providing a combustion chamber at one side of said rib, said casting having another cavity forming an outlet passage at the opposite side

of said rib, said casting being formed to provide a plurality of slots extending circumferentially from said combustion chamber cavity to said outlet passage cavity, said slots being bounded on their open sides by said sleeve so that said sleeve and said slots together provide a plurality of passageways connecting said combustion chamber to said outlet passage, and means to supply fuel to said combustion chamber cavity.

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
1,519,673	Doble	Dec. 16, 1924
1,546,592	Lawrence	July 21, 1925
2,195,264	Simpson	Mar. 26, 1940
2,131,094	Clark	Sept. 27, 1938
2,270,955	McCollum	Jan. 27, 1942
1,406,111	Tuck	Feb. 7, 1922
573,930	Sweet et al.	Dec. 29, 1896
1,117,050	Honegmann	Nov. 10, 1914

FOREIGN PATENTS

Number	Country	Date
201,696	British	Aug. 9, 1923
326,278	British	Mar. 13, 1930