Oct. 28, 1958 W. L. DAVIDSON ET AL 2,857,906

SPACE HEATER

Filed Sept. 13, 1954 4 Sheets-Sheet 1

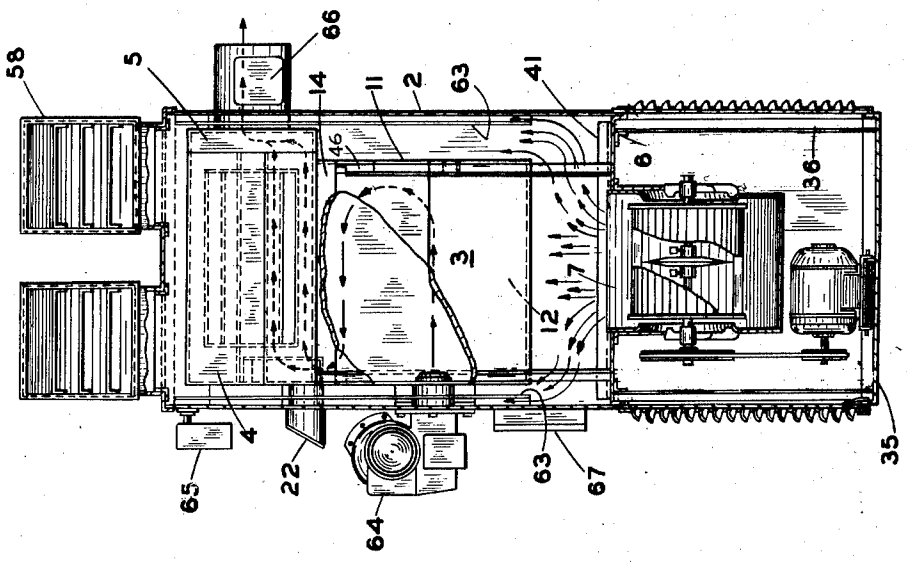


FIG. 2

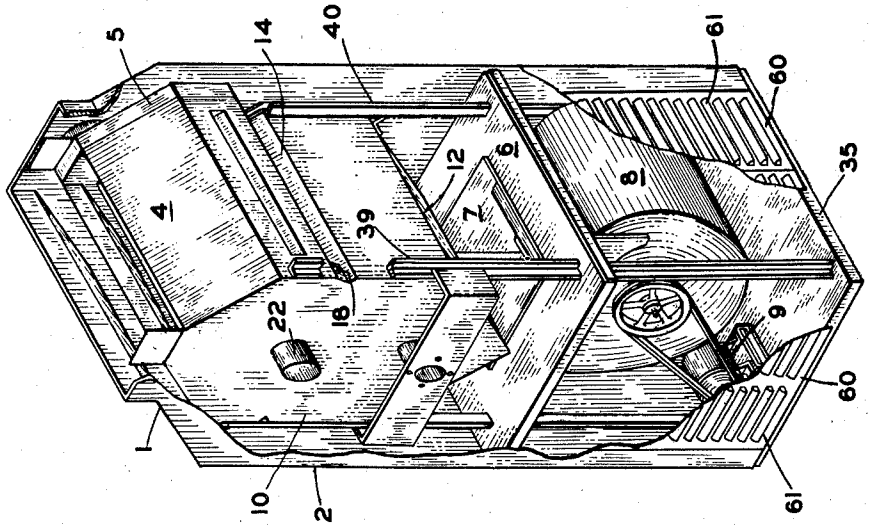


FIG. 1

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SPACE HEATER

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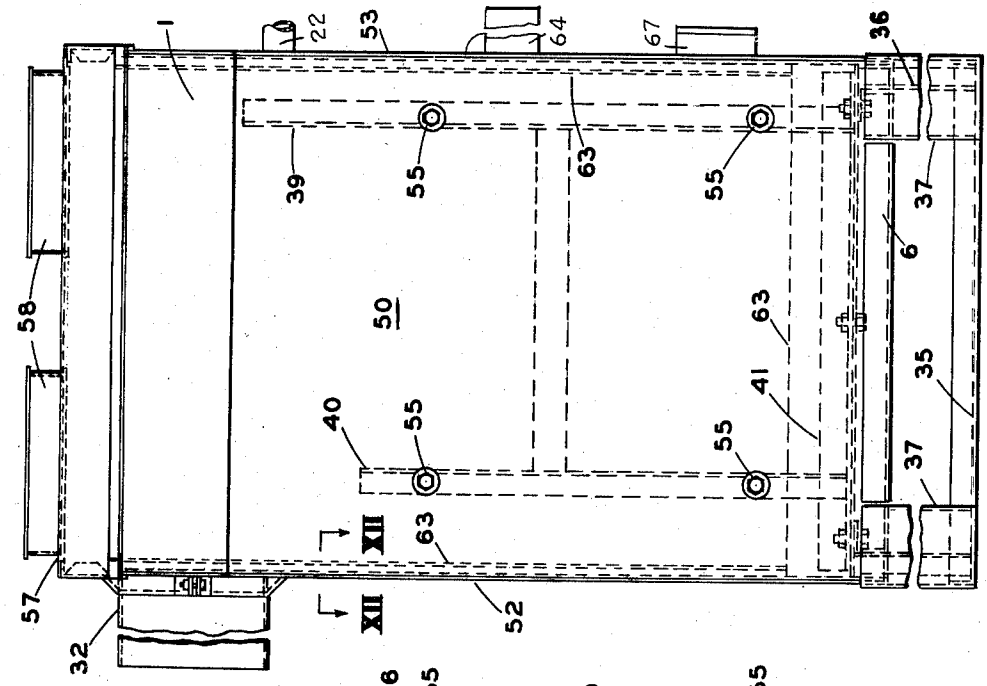


FIG. 4

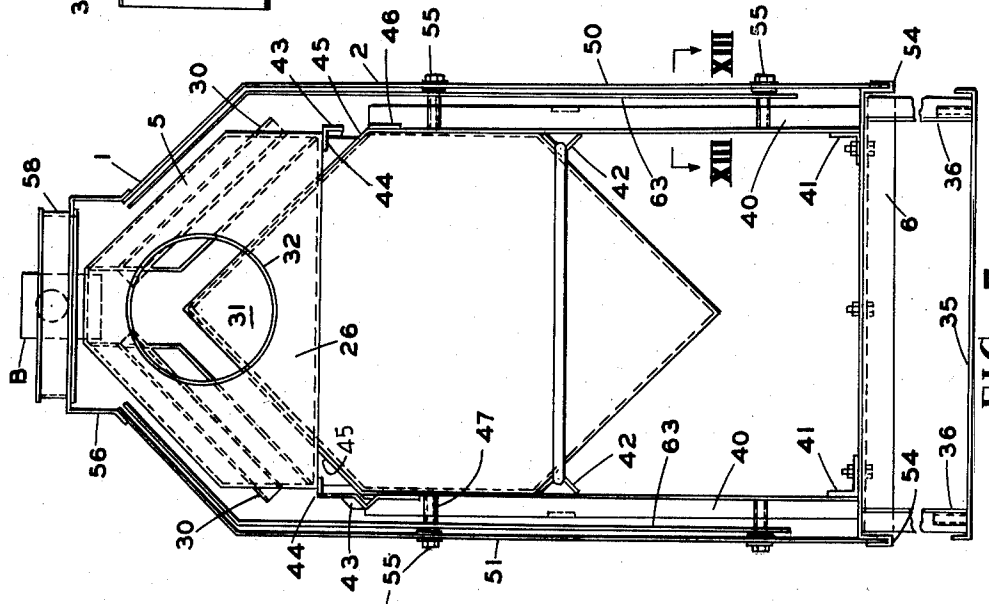


FIG. 3

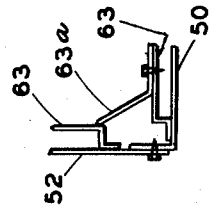


FIG. 12

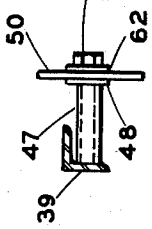


FIG. 13

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SPACE HEATER

Filed Sept. 13, 1954 4 Sheets-Sheet 3

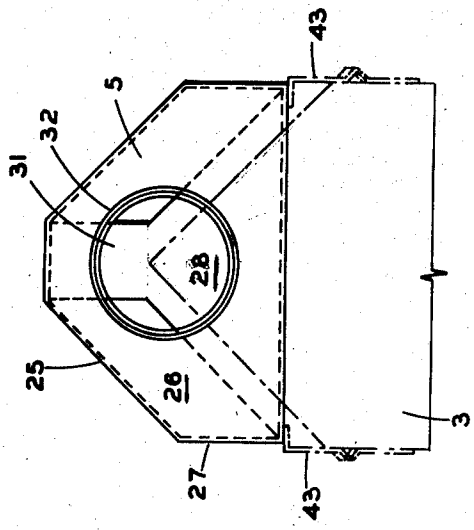


FIG 6

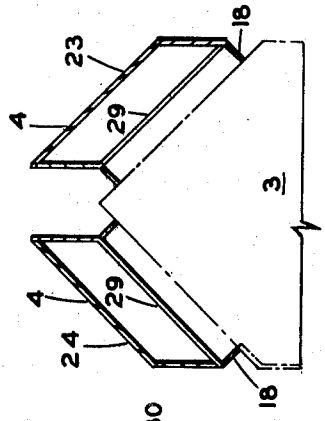


FIG 8

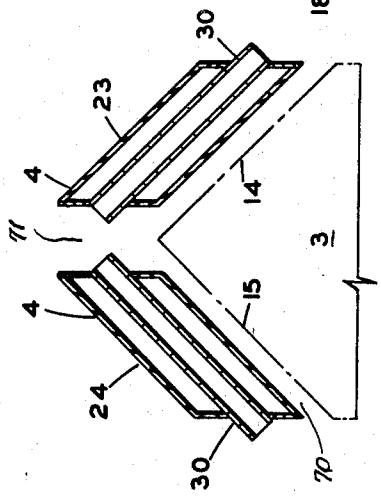


FIG 7

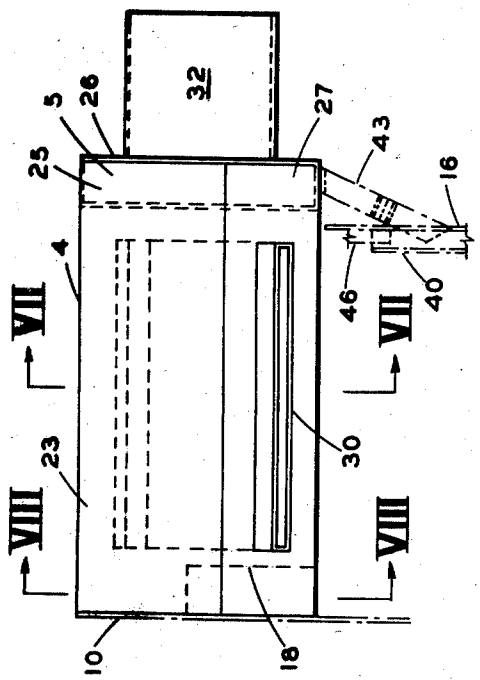


FIG 5

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SPACE HEATER

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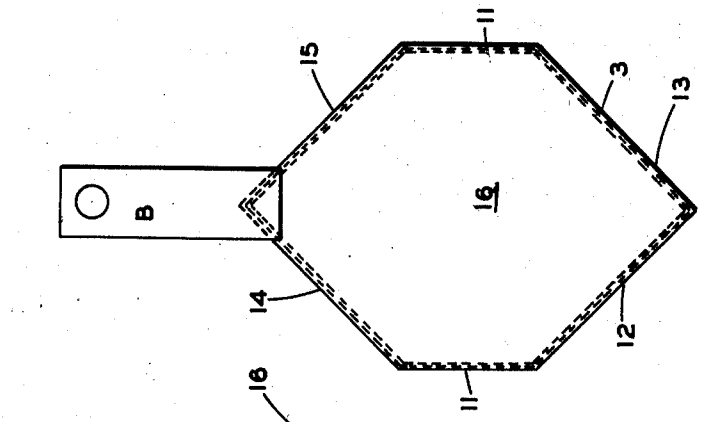


FIG. 11

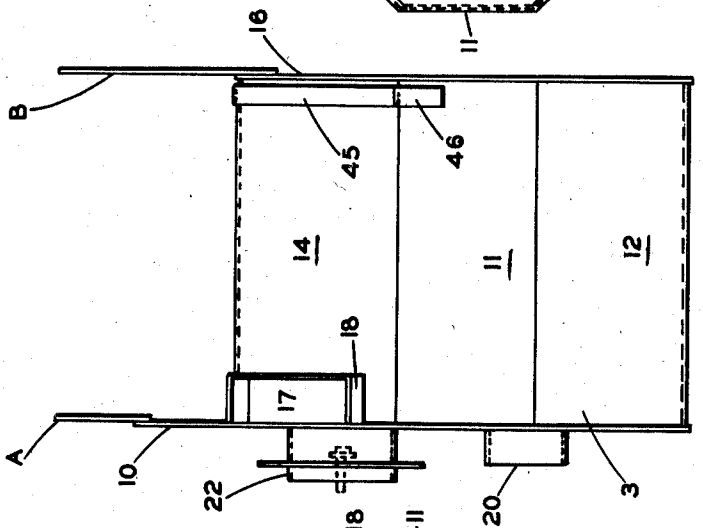


FIG. 9

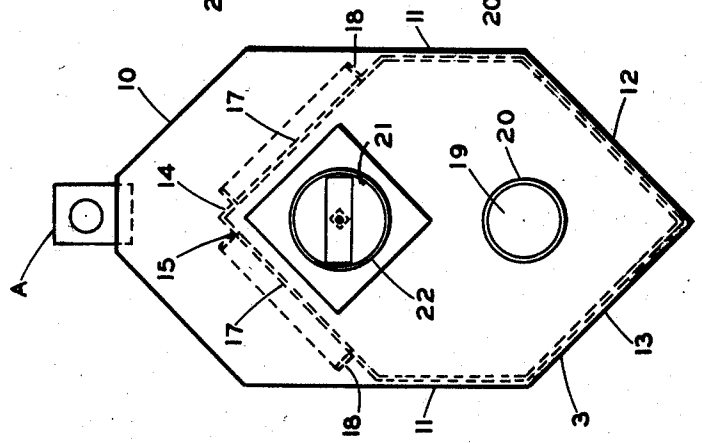


FIG. 10

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2,857,906

SPACE HEATER

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Application September 13, 1954, Serial No. 455,592

1 Claim. (Cl. 126—110)

The present invention pertains generally to space heaters of the type which discharge heated air through ducts to the area being heated or of the ductless type wherein the heated air is discharged from the heater directly into the space to be heated by means of adjustable hoods associated with the air outlets of the heater.

More specifically the invention relates to a combination of combustion chamber and convector plenums so related to each other and to the heater casing so as to obtain improved heating efficiency, minimum obstruction to the flow of air through the casing and maximum flexibility in the mounting of the heater within the area to be heated.

Space heaters of the duct type are well known in the art. Many different designs of heaters and arrangements of the component parts thereof have been made in order to increase the efficiency of such heaters. Space heaters of the ductless type are relatively new in the art and these heaters in addition to the problem of increased efficiency also present additional problems of economy in size and adaptability for mounting in various positions within the area to be heated. The ductless heater by reason of being frequently mounted within a restricted space presents the compound problem of maximum efficiency, minimum space, and maximum flexibility in mounting.

The prior art in an endeavor to obtain increased efficiency provides suggestions for a plurality of passes of the combustion gases through the combustion chamber before discharge to the atmosphere through a suitable stack arrangement. In some instances the prior art also suggests passing the combustion gases exteriorly of the combustion chamber through some form of heat exchange unit to extract additional heat from the combustion gases prior to discharge from the heater. All such arrangements known to the present inventors produces a rather bulky design of heater in which flow of heating air through the heater is usually impeded causing hot spots in the combustion chamber or heat exchange unit with consequential reduced heating efficiency and accelerated deterioration of those portions of the heater in contact with the combustion gases.

In the present heater, by reason of a novel form of combustion chamber, a plurality of passes of the combustion gases through the chamber are obtained and a maximum exposure of the heated surfaces of the chamber is provided whereby the air to be heated flows freely over these surfaces with a minimum of obstruction, an additional heat exchange unit, referred to herein as a convector plenum, is disposed above the top wall of the combustion chamber and in parallel spaced relation thereto so as to provide a plurality of passageways between the plenum and combustion chamber, between the plenums and through the plenums for the air flowing past the combustion chamber. We have used heat resistant metal to construct the combustion chamber and ordinary steel to construct the plenums so that these members may be heated to a much higher temperature

than is possible with ordinary steels. The specific design of the chamber and plenums permits control of the distribution of air to be heated passing over, beneath and around the chamber and plenum so as to control the extraction of heat from the metal thus preventing hot spots which accelerate the rate of deterioration of the metal.

One object of the invention is to provide a combination of combustion chamber and convector plenum which offers a minimum obstruction to heating air passing thereover and distributes such air so as to prevent formation of hot spots in the combustion chamber or convector plenum.

Another object of the invention is to provide a novel form of combustion chamber and convector plenum permitting improved extraction of heat from the combustion gases before being discharged from the heater.

A further object of the invention is to provide a novel form of mounting for the combustion chamber within the heater casing permitting free expansion and contraction of the chamber, during heating cycles, while the heater may be mounted in a plurality of different positions.

These and other objects will be made apparent as the disclosure proceeds. In the drawings forming part of this disclosure, Fig. 1 is an isometric view of the heater showing the combustion chamber, convector plenum, blower fan and casing with portions of the casing removed to better illustrate the arrangement of the parts;

Fig. 2 shows a side elevation of the heater of Fig. 1 with portions of the casing and combustion chamber removed to better show the flow of combustion gases through the chamber and plenum;

Fig. 3 shows the rear end elevation of the heater with a portion of the casing removed to better show the arrangement of the combustion chamber and plenum in relation to the casing of the heater.

Fig. 4 shows a side elevation of the heater showing the arrangement of the casing;

Fig. 5 shows in detail a side elevation of the convector plenum;

Fig. 6 shows a rear elevation of the convector plenum;

Fig. 7 shows a section through the plenum taken along the lines VII—VII of Fig. 5;

Fig. 8 shows a section through the plenum taken along the lines VIII—VIII of Fig. 5;

Fig. 9 shows a side elevation of the combustion chamber;

Fig. 10 shows a front elevation of the combustion chamber;

Fig. 11 shows a rear elevation of the combustion chamber;

Fig. 12 shows a typical corner detail at lines XII—XII of Fig. 4; and

Fig. 13 shows an enlarged detail of the casing support at lines XIII—XIII of Fig. 3.

Referring now in detail to the drawings, reference character 1 refers in general to the heater having an enclosing casing 2, combustion chamber 3 and convector plenums 4 connected by a header plenum 5. Beneath the combustion chamber is an air baffle pan 6 having an opening 7 therein registering with the outlet of a blower fan 8 secured beneath the baffle pan 6 and driven by a suitable motor 9. Above the combustion chamber, a heating air outlet in the casing has suitable hoods associated therewith for directing the heating air in a plurality of directions.

The combustion chamber 3 comprises a front plate 10, side wall portions 11, bottom wall portions 12 and 13, top wall portions 14 and 15, and a rear wall 16. The combustion chamber is of generally hexagonal shape having its longer axis disposed vertically. The chamber is

preferably made of stainless steel and of welded construction. For convenience in welding, the front plate **10** and rear wall **16** of the chamber are made slightly larger than the side, top and bottom walls so that all welds can be of the fillet type and on the exterior of the chamber. Each top wall portion **14** and **15** is provided with a suitable opening **17** for passage of combustion gases from the chamber **3** into the plenums **4**. These openings **17** are adjacent the front wall of the chamber and are enclosed by a suitable conduit **18** for attachment to the adjacent plenum. In the front wall of the chamber adjacent the lower portion thereof a suitable opening **19** is provided and enclosed by a burner tube **20**. Also on the front face of the combustion chamber adjacent the top thereof is an opening **21** enclosed by a tube **22** forming an observation port. Lifting lugs A and B may be provided on the respective front plate **10** and back wall **16** of the combustion chamber for handling the chamber during assembly of the heater, and may also be used for lifting the entire heater.

The convector plenums **23** and **24** are disposed above the combustion chamber top walls **14** and **15** in parallel spaced relation thereto. The plenum **23** is disposed above the top wall **14** and the plenum **24** is disposed above the top wall **15**. Preferably, the outer side wall of each plenum is disposed in substantially vertical alignment with the adjacent side wall of the combustion chamber, and the inner side wall of the plenum is disposed in spaced relation to the center line of the combustion chamber as shown in Fig. 7. The plenums **23** and **24** thus comprise hollow box-like structures extending from the inner face of the combustion chamber front plate **10**, across the combustion chamber and beyond the rear wall **16** thereof. The ends of the plenums, adjacent the rear wall of the combustion chamber, are connected by a header portion **25**. The header **25** is comprised of a continuous rear wall **26** spanning the plenums **23** and **24** with side walls **27** extending outwardly from the periphery of rear wall **26** to conform to the slope of the plenum walls and a front wall **28** filling the space between the adjacent plenum walls and extending downward to the peripheral side wall **27**. Adjacent the front wall of the combustion chamber, each bottom wall **29** of the plenum has an opening therein registering with the opening **17** in the combustion chamber and the registering openings are connected by conduits **18** as shown in Figs. 5 and 8. Extending transversely through each plenum is a hollow box-like structure **30** having its top and bottom walls disposed in spaced relation to the top and bottom walls of the respective plenum and having its side walls disposed in spaced relation to the side walls of the plenum. The ends of the members **30** protrude slightly beyond the vertical faces of the plenum members **23** and **24** as shown in Fig. 7. The member **30** thus provides a passage for heating air through the member **30** and combustion gases flowing through the plenum pass around the member **30**. The rear face **26** of the header **25** has an opening **31** therein and a conduit **32** mounted on the rear wall of the header in register with the opening **31** provides for exit of the combustion gases from the plenum header to the atmosphere.

Within the casing **2** is a suitable support for the combustion chamber comprising a bottom pan **35** having at the corners thereof members **36** connecting the bottom pan with the baffle pan **6**. Adjacent each corner of the bottom pan is a suitable supporting member such as the angle **37** supported on the bottom pan **35** and extending upwardly for connection with the under side of the baffle pan **6** by means of suitable clip members **38**. Disposed above the baffle pan **6** are a pair of frame members **39** disposed adjacent the front plate **10** of the combustion chamber and secured thereto. At the rear of the combustion chamber are a pair of members **40** disposed on opposite sides of the combustion chamber but not attached thereto. The members **39** and **40** on opposite sides of the combustion chamber are connected by a suitable member such as the angle **41** which is secured to the members and to the baffle pan. At the rear of the combustion chamber are the members **42** secured to the members **40** and in engagement with the sloping bottom walls **12—13** of the combustion chamber providing sliding support therefor. The members **42** are rigidly attached to the members **40** but merely slidably engaged with the bottom walls of the combustion chamber so as to permit the combustion chamber to move relative to the members **42** during expansion and contraction of the chamber. Adjacent the upper ends of the members **40** are the supporting members **43** fastened to one leg of the members **40** and extending upwardly therefrom so as to terminate in a flange **44** disposed beneath the wall **27** of the convector plenum header **25** providing a support for the plenum header upon which the header may move during expansion and contraction of the plenum and header. Adjacent the rear of the combustion chamber is a strap **45** engaging the top of the combustion chamber and extending downwardly along the top walls of the chamber so as to terminate in flange portions **46** overlying and welded to the members **40**. This strap member **45** is not connected to the combustion chamber but serves to retain the chamber and associated plenum in fixed relation to the supports **43** and **42** when the heater is mounted in an inverted position. Each of the members **39** and **40** have secured thereto, in vertically spaced relation, separators **47** having one end secured to the members **39** and **40** as by welding, the opposite end of the members **47** having a plate washer **48** welded to the member **47** to serve as a spacer for the casing members. The separator **47** is provided with internal threads.

The outer casing of the heater may be mounted upon the above described combustion chamber supporting frame in any suitable manner. One method of supporting the casing would be to provide the casing side sheets **50** and **51** with side flanges to which would be secured the rear casing sheet **52** and front casing sheet **53** as shown in Fig. 12. Sheet **52** is provided with a suitable opening through which the plenum header conduit **32** extends and the sheet **53** is provided with suitable openings through which the burner tube **20** and observation port tube **22** extend. The side sheets **50** and **51** are provided with suitable lateral supports by means of the flanges **54** of the baffle pan **6** and provided with vertical and lateral support by means of stud bolts **55** extending through the casing sheets and threaded into the separators **47** secured to the combustion chamber frame members **39** and **40**. The upper ends of the casing sheets **50—51** would conform to the slope of the upper surface of the plenums **23** and **24**, being disposed in spaced relation thereto, and joined by a suitable collar **56** extending over and secured thereto. The casing sheets **52—53** would extend vertically upward with their upper ends conforming to the slope of the side sheets **50** and **51** so as to be disposed beneath and connected with the collar **56**. Disposed upon the collar **56** is a nozzle pan **57** of suitable design for attachment to the collar and provided with apertures **58** for reception of the air directional nozzles **59**. The casing about the combustion chamber when constructed in this manner will have adequate vertical support as well as transverse support supplied by the stud bolts **55** which are anchored in the framing members **39** and **40**, and their lower ends secured against lateral displacement by means of the flanges **54** of the baffle pan **6**. The portion of the casing about the blower fan is preferably formed of casing members **60** provided with louvers **61** and secured to the bottom pan **35** and baffle pan **6**. As clearly shown in Figs. 3 and 4 of the drawings the outer casing sheets **50** and **51** are supplied with a suitable bearing by means of the washer plates **48** and may be provided with an additional plate washer **62** disposed upon the outer face of the casing sheets and beneath the head of the stud bolt **55**, as shown in Fig. 13.

Within the casing and adjacent the casing plates **50—51—52—53** are preferably provided heat shields **63**. These are preferably of heat resistant metal such as stainless steel and disposed in slight spaced relation to the outer casing sheets, as shown in Fig. 12. These heat shield sheets **63** are preferably provided with side flanges secured to the adjacent casing sheets and at the sides of the casing are provided with suitable openings for passage of the separators **45** which provide vertical support for the casing sheets. As clearly shown in Figs. 3 and 4 of the drawings the upper ends of the heat shields **63** secured to the side sheathing plates **50** and **51** extend upwardly for substantially the full length of the latter sheets and conform to the contour thereof. At the corners of the casing, corner heat shields **63***a* are provided.

During operation of the heater, it may be mounted upon its base **35** as shown in Fig. 1 of the drawing, or it may be suspended in an inverted position. Where desirable it may be mounted in a horizontal position. When inverted the combustion chamber supporting members **39** and **40** by reason of their connection with the chamber, either directly or through strap **45**, retain the chamber in operating position. A suitable burner **64** is mounted in the burner tube **20**. Such a burner may be any one of the commercial forms now available and preferably adapted for burning either oil or gas. A fan and limit switch **65** may be provided in the upper portion of the casing and a stack switch **66** may be mounted in the combustion gas outlet conduit **32** for automatic control of the operation of the heater. A suitable control panel **67** may be mounted on the casing and connected with the fan, stack and burner controls. A suitable stack (not shown) would be connected with the conduit **32**. The design of the heater makes it suitable for natural draft operation, but forced or induced draft may be used where desired.

After the burner is placed in operation, the combustion flame is preferably adjusted so as to direct the burning fuel to adjacent the rear wall of the combustion chamber as shown in Fig. 2 of the drawings. Due to the natural draft of the stack the combustion gases will then be deflected upwardly and flow towards the front wall of the combustion chamber where they will pass out of the chamber through the openings **17** and the conduits **18** in the top wall portions **14—15** of the combustion chamber into the converter plenums **23** and **24**. The combustion gases will then flow through the convector plenums and around the members **30** into the header **25** adjacent the rear of the heater where they will be accumlated and pass through the conduit **32** into the stack and to the atmosphere. The heater is provided with suitable automatic controls so that after the combustion chamber and plenum had been raised to a suitable temperature, the blower fan is started to and blows air into the substantially closed combustion chamber casing as shown in Fig. 2 of the drawings. The air from the blower flows upwardly about all surfaces of the combustion chamber and at the sides of the chamber flows through the spaces **70**, between the plenums and the top wall of the combustion chamber, into the space **71**, between the inner ends of the plenums and outwardly through the nozzles **59**. Some of the air passing upwardly along the sides of the combustion chamber will flow through the member **30** into the spaces **71** and other portions of the air flowing upwardly from the sides of the combustion chamber will flow between the top walls of the plenums and the heat shields **63** to the nozzles **59**. Likewise at the sides of the combustion chamber the air will flow between the heat shields **63** and the sides of the outer sheathing cooling the sheathing and pass upwardly to the nozzles **59**. At the front of the combustion chamber the upwardly flowing air will wipe the front plate **10** of the combustion chamber and flow to the nozzles **59**. At the rear of the combustion chamber the upwardly

flowing air passes over the header portion **25** in flowing to the nozzles **59**. The spacing between each convector plenum and the top wall of the combustion chamber, as well as the size of all the other air passages hereinbefore recited, can be of such size as to adequately and uniformly cool the adjacent surfaces preventing hot spots. By reason of the use of stainless steel the combustion chamber and plenums can be raised to a high temperature which contributes to the efficiency of the heater. As will be apparent from an examination of the drawings there are no abrupt changes of direction of the heating air flowing over the combustion chamber and convector plenums which would also contribute to hot spots.

The details of construction shown on the drawings are for purposes of illustration and not limitation except as necessitated by the scope of the appended claim.

In a space heater, a closed combustion chamber having side walls, a top wall connecting said chamber side walls and having opposite faces converging inwardly and upwardly from each side wall, a bottom wall connecting said chamber side walls, and front and rear walls connecting said side, top and bottom walls, said front wall having an extension above said top wall, a substantially rectangular hollow convector plenum disposed above each converging face of the chamber top wall in parallel spaced relation thereto, the opposing adjacent inner side walls of said plenums being spaced from each other to provide an air passageway between them above the connected converging faces of said chamber top wall, a conduit connecting the interior of each plenum with the interior of the combustion chamber through the adjacent chamber top wall and disposed adjacent the chamber front wall, a header connecting the ends of the plenums adjacent the said chamber rear wall, means attaching said chamber front wall extension to the adjacent ends of the plenums, there being openings in opposite side walls of each plenum and a hollow member extending between said openings, said hollow member being secured to the convector plenum side walls forming a passageway through which air passes into said air passageway and about which combustion gases flow in passing from the combustion chamber to the plenum header, a casing enclosing the combustion chamber and the plenums, said casing having side, front and rear walls spaced from corresponding walls of the chamber and plenums directing air to be heated over such latter walls and through the spaces between the plenums and chamber walls and through the passageways of the plenums, a heated air outlet in the casing above said chamber, a combustion gas outlet conduit extending through said casing into the plenum header, means forming a registering inlet opening in the front face of the combustion chamber and casing, a combustion burner nozzle extending through said openings, and means including a fan within the casing disposed below said combustion chamber for forcing air to be heated over said chamber and plenums to said heated air outlet.

References Cited in the file of this patent

UNITED STATES PATENTS

1,218,288	McPherson	Mar. 6, 1917
1,634,706	Carroll	July 5, 1927
1,991,449	Cornelius	Feb. 19, 1935
2,109,876	Bard	Mar. 1, 1938
2,114,584	Aunger	Apr. 19, 1938
2,160,269	Jorolemon	May 30, 1939
2,172,667	Nelson	Sept. 12, 1939
2,376,140	Henderson et al.	May 15, 1945
2,430,393	Elmore	Nov. 4, 1947
2,514,011	Ruff	July 4, 1950
2,555,842	De Lancey	June 5, 1951
2,612,153	Gibler	Sept. 30, 1952