April 12, 1966 M. O. LAWSON 3,245,399

GAS HEATER

Filed July 24, 1963 3 Sheets-Sheet 1

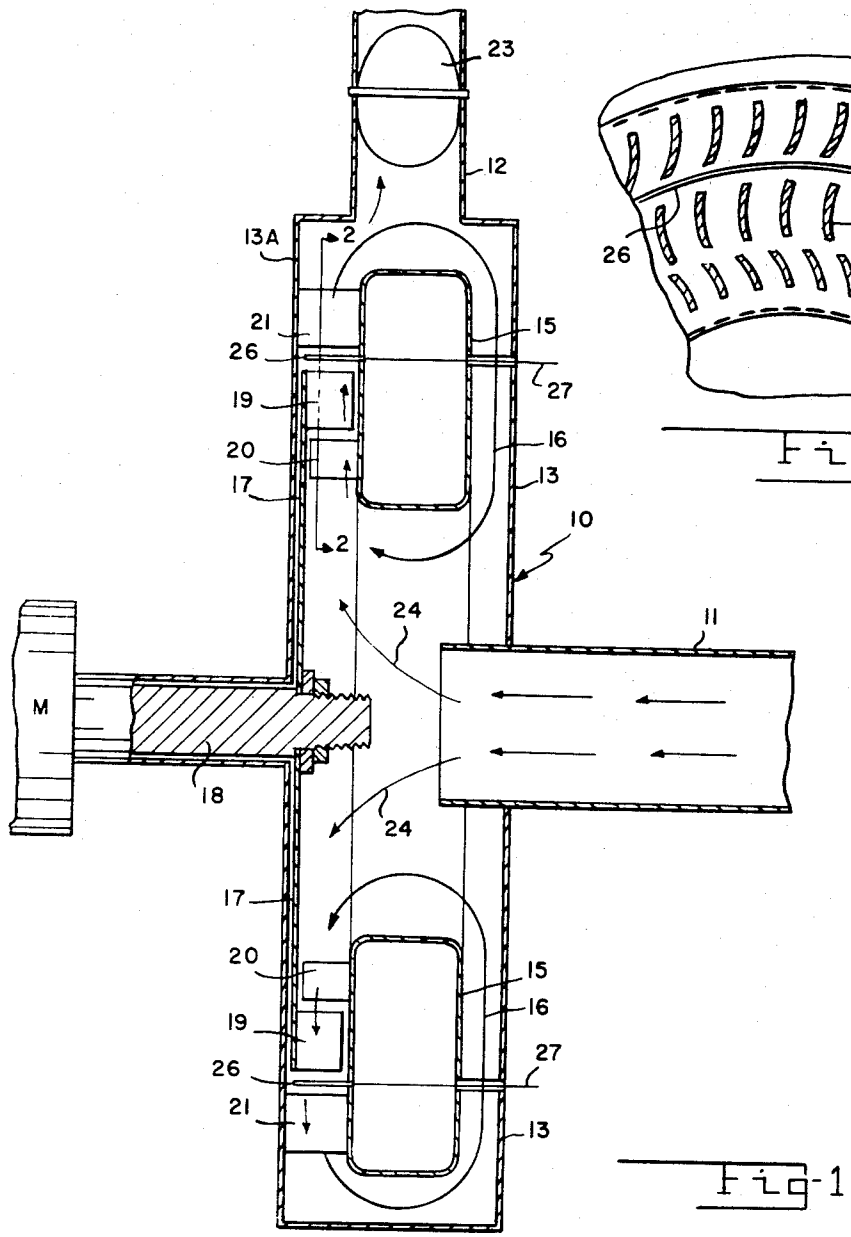


Fig-1

Fig-2

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GAS HEATER

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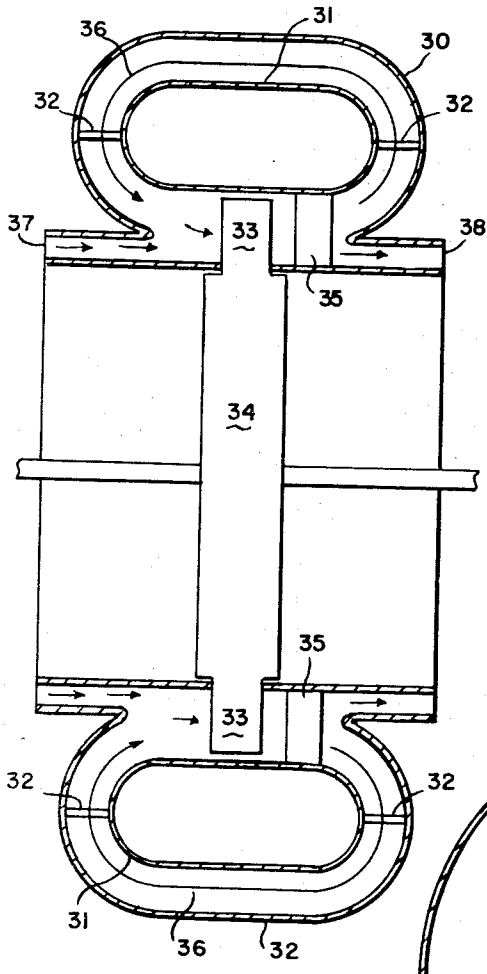


Fig. 3

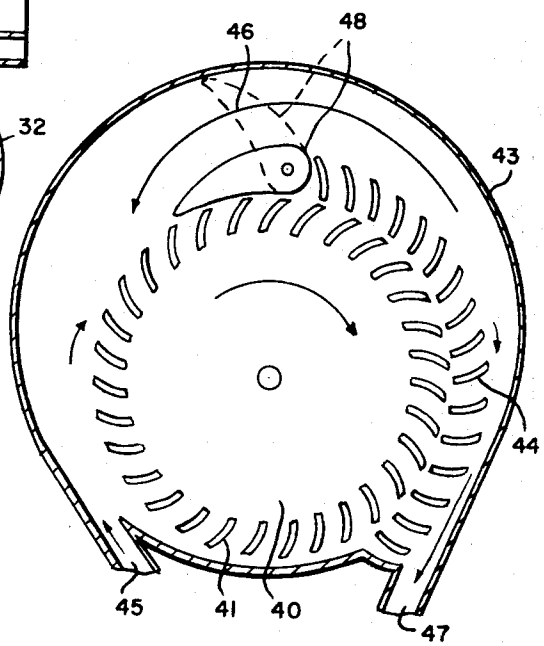


Fig. 4

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GAS HEATER

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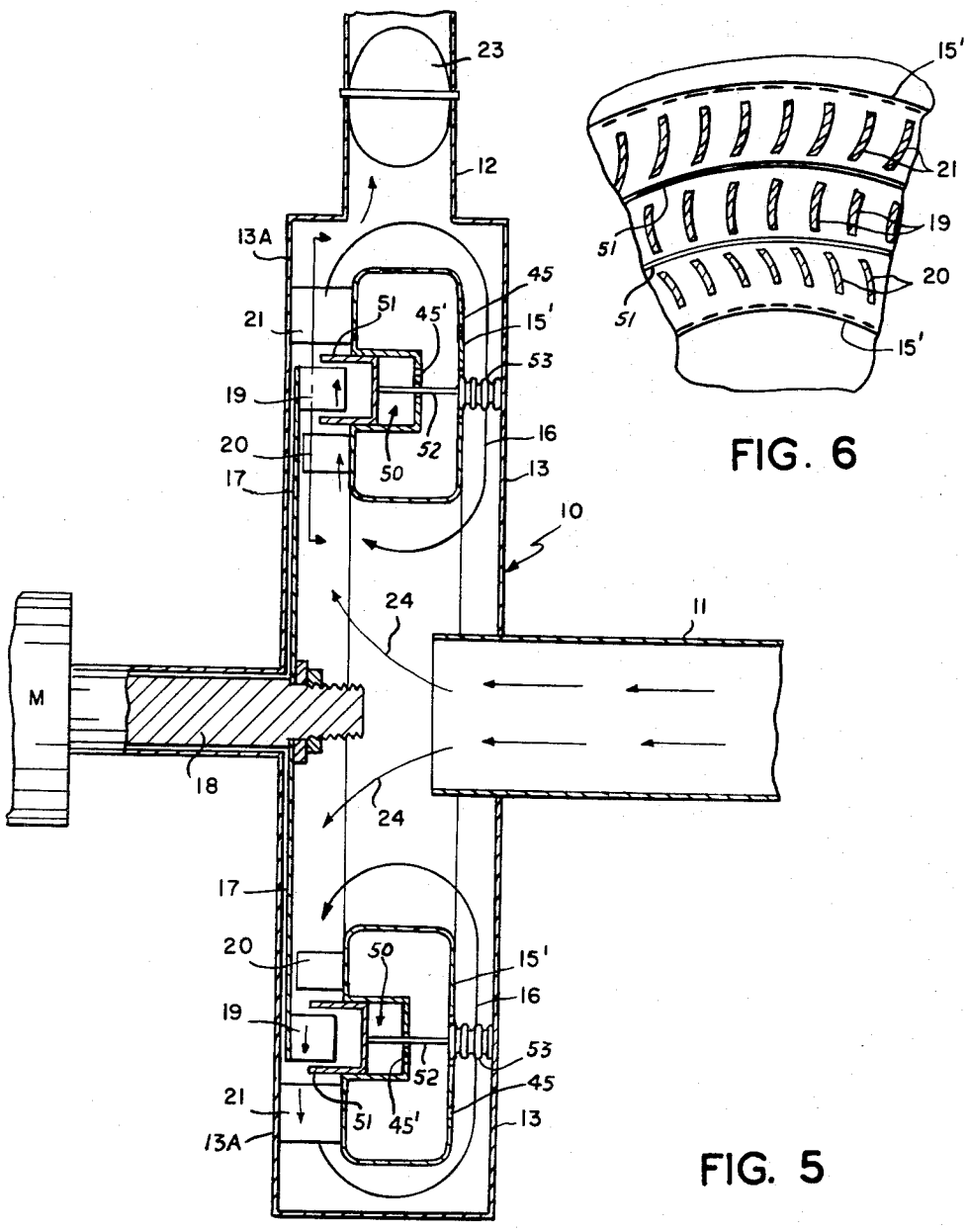


FIG. 5

FIG. 6

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GAS HEATER

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Filed July 24, 1963, Ser. No. 297,389
18 Claims. (Cl. 126—247)

The present invention constitutes a continuation in part of that disclosed in my co-pending application for United States Letters Patent Serial No. 107,598, filed May 3, 1961, and now abandoned. The improvements herein enable a gas heater having an optimal efficiency.

This invention relates to a gas heater and more particularly to a recirculation type continuous flow heat pump. It has prime utility when embodied in a heater for automotive vehicles and will be so described. However, neither its application nor the form of its embodiment need be so limited. Such is certainly not intended.

A primary object of the invention is to provide a gas heater which may be economically fabricated, more efficient and satisfactory in use, adaptable to a wide variety of applications and unlikely to malfunction.

A further object of the invention is to provide a continuous flow heat pump capable of producing a substantial rise in a gas temperature in a relatively short period of time.

Another object of the invention is to provide a small, compact, continuous flow heat pump which will achieve a high degree of operating efficiency after a very brief interval of operation.

Another object of the invention is to provide a heater for use in automotive vehicles or the like which can achieve substantially 100 percent operating efficiency.

An additional object of the invention is to provide a single stage recirculation type heater so designed to overcome substantially all losses such as normally occur in heater operation.

Another object of the invention is to provide a recirculation type gas heater which can achieve a satisfactory heat flow in a matter of seconds.

A further object of the invention is to provide a gas heater possessing the advantageous structural features, the inherent meritorious characteristics and the mode of operation herein mentioned.

With the above and other incidental objects in view as will more fully appear in the specification, the invention intended to be protected by Letters Patent consists of the features of construction, the parts and combinations thereof, and the mode of operation as hereinafter described or illustrated in the accompanying drawings, or their equivalents.

Referring to the accompanying drawings wherein are shown some but obviously not necessarily all the forms of embodiment of the invention,

FIG. 1 is a schematic view of a continuous flow heat pump according to one embodiment of the invention;

FIG. 2 is a cut away sectional view of the device of FIG. 1 taken along the line 2—2;

FIG. 3 shows a schematic view of a modification of the device of FIG. 1;

FIG. 4 shows a further modification of the device of FIG. 1; and

FIGS. 5 and 6 schematically illustrate a preferred embodiment of the invention.

Like parts are indicated by similar characters of reference throughout the several views.

It is well known that the power absorption of an axial flow rotor or radial flow rotor can be very high even when designed for the specific purpose of compressing a gas. For example, an axial flow compressor rotor having a power absorption of 24 H.P. (or 61,000 B.t.u./hour) per square inch of blade inlet frontal area has been tested. (The gas used was air at atmospheric pressure.) In general, the high power capability per unit blade frontal area results from the very high mass flux (flow per unit frontal area). Moreover, the gas on which the rotor operates incurs a temperature rise in flow therethrough which is in direct proportion to its power absorption. With this in mind, consider the fact that the temperature rise of air moved through a radial flow rotor with a peripheral speed of 250 ft./sec. is about 10° F. Thus, to accomplish a 200° F. rise by placing such rotors in series, approximately twenty would be needed.

In the present invention, the above mentioned high mass flux capability is utilized fully by recirculating the same gas through a heater many times so that its internal flow volume is many times that entering, or leaving, the heater. Based on this premise, to produce a 200° F. rise in temperature of gas entering a heater, using a 10° F. rise rotor, the invention provides that twenty times as much gas is continuously passed through the rotor as that which enters the heater. The invention also provides for the recirculation of the same gas through one rotor via the shortest possible route which presents the least surface for the gas to contact within the heater, and thus permits the mose rapid temperature rise of the gas, an important feature of the invention.

The invention is basically exemplified by the embodiment shown by FIGS. 1 and 2 of the drawing wherein **10** refers to a continuous flow heat pump having a gas inlet tube **11** and outlet tube **12** in connection with a heat chamber housing **13**. An annular body **15** is centrally located within the housing **13** to form a gas recirculation path indicated by the arrow **16**. A fan or rotor **17**, driven by a shaft **18** from a power supply indicated at M, has essentially radial blades **19** on the outer peripheral portion thereof opposite and relatively adjacent one side of the body **15**.

Fixed on the central body **15** in the path of flow to the blades **19** are inlet vanes **20**. Surrounding the rotor **17** on the outlet side of the blades **19** is a circular row of spaced stator blades **21**. The blades **21** are secured to the central body **15** and housing **13** by any well-known means such as welding.

As is obvious, the vanes **21** serve to support the central body **15** in a fixed relation to the housing **13**.

A butterfly valve **23** is located in the outlet tube **12**. A similar valve may be employed in the inlet tube **11**, if desired, but this is not essential to the invention. A sleeve valve **26** bears in and projects from the body **15** in the space between the rotor blades **19** and stator blades **21**. The valve **26** is operated by a means of a plurality of control rods, two of which are shown at **27**.

In operation of the device described, about nine out of ten parts of the air or other gas passing the fan or rotor **17** is recirculated along the path **16** and mixed with one part air or other gas indicated by the arrow **24** as sucked in through the inlet **11**. This mixture is then drawn to the rotor inlet. The guide vanes **20** at the rotor inlet are formed to receive and provide a rotation of this gas against the direction of rotation of the rotor, as shown in FIG. 2 of the drawings. The spinning rotor **17** and the blades **19** act on and add energy to this gas to thereby raise its temperature. For a 250 feet per second peripheral speed rotor, the rise in temperature is about 20° F. This 20° F. temperature rise is due, in part, to the particular shape of the rotor blades wherein the outlet portions, instead of being directly radial, are curved in a forward direction. Another factor in this temperature rise is the use of inlet vanes **20** so formed as to produce a rotation of the gas against the direction of the rotation of the rotor. As the gas moves tangentially from the rotor blades **19**, the stator vanes **21** function to remove

its angular velocity and convert it to static pressure, thereby increasing the existing static pressure at this point. One of the ten parts of the gas so heated will be permitted to exit past valve **23** and through the outlet tube **12** while the other nine parts are caused to recirculate once more and mix with one part gas drawn through the inlet **11** to repeat the cycle as previously described. With any particular setting of valve **26**, when the requested discharge temperature is reached, the system achieves a "steady" condition. At this point the hot recirculated gas has achieved a constant level and mixes with a predetermined portion of incoming cold air and a constant temperature is reached at the inlet to the rotor.

While only one outlet tube has been shown, it is obvious that more than one may be used, if so desired.

The annular valve **26** acts to control the power absorption of the rotor and thus controls the amount of heat added to the air. By moving the valve **26** to selectively bridge the passage between the rotor blades **19** and the stator blades **21**, one may selectively control the temperature of the gas delivered through the outlet **12**. It is noted that the designed temperature rise for the heater illustrated, from inlet to outlet, for air, is 200° F. and the mass flow is 0.1 pound/second. Noting FIG. 1 of the drawings, the device as shown provides for a single recirculation path **16**. If the application so requires, a like path may be provided by removing the housing wall **13A** and providing another chamber and central body adjacent this side of the housing **13** in a manner believed obvious.

Though the device of FIGS. 1 and 2 of the drawings shows a radial flow rotor, an axial flow type rotor may be used, as shown in FIG. 3. This rotor is peripherally contained by a toroidal shaped housing **30** open at its inner side to accommodate the rotor blades **33**. A toroidal shaped body **31** is supported centrally of the housing **30** by means of round or streamlined pins **32** secured to the body **31** and housing **30** by welding or other suitable means. So supported, the body **31** defines a fixed flow path **36**, through the medium of a hub **34** to which they passage defined between the rotor housing which is tubular and tubular projections at the opening to the housing **30** which are concentric to the rotor housing. As shown in the drawings, blades **33** are driven through the flow path **36** through the medium of a hub **34** to which they mount. A row of stator blades **35** are fixed between the body **31** and the rotor housing on the output side of the blades **33** to operate in the same manner as the blades **21** in the device of FIG. 1 of the drawings. While inlet vanes are not shown in this embodiment of the invention, they may be used if required to permit operation of the included rotor at a lower r.p.m. In this embodiment air is recirculated through the path indicated by the arrow **36** to communicate and mix with air drawn through the inlet **37** of the aforementioned tubular passage by the spinning rotor blades **33** in the same manner as occurs in the device of FIG. 1. The blades **33** operate on this air and in flow of the air thereby, its temperature is raised the designed increment. The stator blades **35** to operate in the manner described with reference to the blades **21**. The outlet **38** from the aforementioned tubular passage permits only a fraction of the heated air to be taken off at this point while a major amount of the previously recirculated air is again recirculated through the path **36**. The flow of the gas recirculated in the path **36** is under the influence of the static pressure factor which is introduced in the air as it passes the stator blades **35**.

An iris diaphragm type control valve may be included in the outlet **38**. However, it would be preferable to communicate the outlet **38** with a small cylindrical tube and locate a butterfly type control valve therein. One may also place a recirculation control valve of the iris diaphragm type between the blades **33** and **35**. However, for this embodiment of the invention the temperature of the delivered air can be better controlled by controlling the speed of the rotor unit.

The device as shown in FIG. 4 of the drawings reveals, in schematic fashion, a fan **40** including blades **41** which provides a rotor element eccentrically positioned within a cylindrically formed housing **43**, the sides of which are flat. At its periphery, the housing **43** includes a tangentially oriented inlet **45** and a tangentially oriented outlet **47** which are relatively closely spaced. Fixed between the walls of the housing **43** on the outlet side of the blades **41** is an arcuate row of spaced stator blades **44**. The blades **44** perform the same function here as the blades **21** in the first described embodiment. On rotation of the fan **40**, its blades **41** drive air including a component from the inlet **45** in a circular path from the inlet in the direction of the outlet **47**. This air is driven through the stator blades **44** and a portion is permitted to exit through the outlet **47** adjacent thereto while the blades **44** direct the major portion of the air which has had an increment of heat added in the process to recirculate. The air is recirculated in an arcuate path back towards the inlet **45** adjacent which it will mix with a fraction of fresh air drawn through the inlet by the moving rotor **40**. The mixed air is picked up once more by the blades **41** for another cycle, as described, during which an additional increment of heat is added to the recirculated air. As is evident in FIG. 4 of the drawings, a valve member **48** is pivoted between the walls of the housing **43** at one end of the arcuate row of spaced stator blades **44**. The adjustment of this valve **48** to vary the recirculation passage provides a control of the amount of air which is recirculated and therefore a control of the temperature rise produced in movement of a charge of air through the described heater unit.

The heater unit as revealed in FIG. 4 of the drawings has the utmost simplicity in its designed features and is of a most economical construction.

If the heater in accordance with the invention must be operated at a very high temperature, it may be necessary to cool the central body portions thereof such as the body **15** in the device of FIG. 1 and the body **31** in the device of FIG. 3. In some instances it may be well to cool the fan or rotor blades. The central bodies may be cooled in either case by directing gas through openings in their body walls. Where hollow fan or rotor blades are employed, openings may be made in these elements to provide for a flow of cooling gas therethrough in any suitable manner. This cooling gas may also serve as a portion of the gas to be heated.

While no insulation has been shown in any of the aforementioned devices of the invention, this is purely an optional design element and may be employed in the areas necessary, dependent on the particular application. In reference to the material to be employed for the invention embodiments, the particular material to be used is not critical as long as it will withstand the heat and provide a substantially smooth surface to insure a low friction on flow of gas thereabout. As a matter of fact, the entire heater of the invention can be made of metal.

The previously described embodiments reveal basic aspects of the invention. However a preferred embodiment having optimal control features is illustrated in FIGS. 5 and 6 of the drawings. The device here shown is similar to that revealed in FIGS. 1 and 2. However in this case the control feature is such to produce a heater unit or heat pump which has substantially 100 percent operating efficiency. This device is eminently suited for use as a heater unit in automotive vehicles and the like.

The portions of the device of FIGS. 5 and 6 which are identical with portions of the device of FIGS. 1 and 2 have been identified by the same numerals. Thus, the device of FIGS. 5 and 6 similarly includes a housing **13** which forms a heat chamber having a cylindrical configuration and includes an inlet **11** and an outlet **12**. Oriented centrally of the chamber **13** is an annular hollow body **15'** the inner wall of which positions in concentric spaced relation to the inner extremity of the inlet **11**.

The inlet **11** is defined by a tube which mounts centrally of one wall of the chamber **13**. Arranged coaxial with the inlet **11** and extending inwardly from the opposite wall **13A** is the projected extremity of a drive shaft **18** which is powered by a motor M. Mounted on the projected extremity of the shaft **18** adjacent and parallel to the chamber wall **13A** is a rotor disc **17**. Arranged generally perpendicular to the innermost face of the rotor **17**, equidistantly spaced about its outer periphery are blades **19**. The blades **19** have a general radial orientation except that their inner and outer peripheral portions are curved in the direction of their rotation. The one face of the body **15'** is positioned immediately adjacent the projected extremities of the blades **19** which define a path which is centered relative thereto.

The body **15'** mounts a row of circularly spaced stator blades **20** fixed immediately inward of the blades **19**, concentric therewith. The blades **20** are formed to define a predetermined path for flow of air to the rotor blades **19** in a direction counter to their normal rotation under the influence of the drive shaft **18**. A further row of circularly spaced stator blades **21** is positioned on the output side of the blades **19**, spaced therefrom and concentric therewith. The blades **21** are fixed to interconnect the body **15'** with the chamber wall **13A** and to fix the body centrally of the chamber **13**. Blades **21** are thereby interposed in the path of air flow from blades **19** as and for purposes to be further described.

As in the case of the device of FIGS. 1 and 2 of the drawings, butterfly valve **23** is positioned to selectively close the passage through the outlet **12**.

Thus, the blades **19** are oriented intermediate and respectively spaced from the rows of stator blades **20** and **21**. The face of the body **15'** which is relatively adjacent the projected extremities of the blades **19** includes an annular recess accommodating an annular shroud **50**. The shroud **50** is U-shaped in cross-section and its open end which projects relative the body **15'** includes spaced cylindrical walls **51** which dispose to either side of the blades **19**. The shroud **50** is under the control of a pair of diametrically spaced rods **52** which respectively connect to their inner ends to the closed end of the shroud **50** and extend through and bear in the adjacent outer wall of the body **15'**. Each of the relatively projected extremities of the rods **52** connect to one end of bellows type thermostat **53**, the opposite end of which anchors to the outermost wall of the chamber **13** adjacent thereto. Thermostats **53** function in a manner to be further described to cause the wall portions **51** of the shroud **50** to selectively enclose the blades **19**.

Referring more particularly to the drawings, it is to be noted that in the use of the above described embodiment of the invention as a heater for an automotive vehicle, prior to an engine being started, there will be air in the chamber **13**. When the engine starts, the shaft **18** will be energized to turn the rotor **17** and the blades **19** therewith. The turning of the rotor **17** will cause a fractional inflow of air through the inlet **11** to mix with the air in chamber **13**. This air mixture is induced to move to the rotor inlet and through the stator blades **20**. The stator blades **20** introduce a rotational influence to the delivered air in a direction opposite to the movement of the blades **19**. This increases the power absorption of the rotor and enables the blades **19** as they work on the air delivered thereto to introduce a significant amount of heat and cause a significant rise in its temperature. As the air is caused to leave the blades **19**, the air moves off in tangential fashion. This air has a high angular velocity which is not useful for transporting the air to the outlet or for recirculating the air back to the inlet. In the instance of the invention, the row of stator blades **21** is formed to radially direct the flow path of this air to eliminate the angular velocity and convert it to a significant static pressure. Dependent on the positioning of the demand throttle which may be connected in any suitable manner to the butterfly valve **23**, a fraction of the heated air will be delivered through the outlet **12**. The build up of static pressure as the heated air passes through the blades **21** introduces a factor which causes a high speed movement of the remainder of the air to recirculate in a transverse sense through the flow path **16** about the body **15'**. This path leads from the outer periphery to the inner periphery of the body **15'**. At the inner periphery, the recirculated and heated air delivered to this point will induct a fractional amount of air in through the inlet **11** corresponding to the fractional amount of air delivered through the outlet **12**. The air so mixed is again circulated in the manner previously described. It will be obvious that since only a fractional amount of heated air is discharged in any one cycle the temperature of the air within the chamber **13** is rapidly increased by the continuous recirculation process until an equilibrium condition corresponding to a desired temperature is attained.

Utilizing the invention features, from a standing start, the heater illustrated can produce 50% of the demand within approximately thirty seconds and 100% of the demand within approximately one minute.

As is obvious, the thermostat **53** may have a selective setting that when the butterfly valve **23** is closed, it reacts to the build up of heat in the chamber **13** which is occasioned thereby to cause the shroud **50** to close over the blades **19** and limit the working surface thereof which can produce heat. In contrast, when the butterfly valve **23** is opened, producing a greater demand, the air within the chamber **13** will initially become cooler whereupon the thermostats will function to draw the shroud **50** inwardly of the body **15'** to expose a greater part of the working surfaces of the blades **19** to function, absorb power and produce heat in the gas on which they operate, the gas in the example illustrated being air.

The function of the shroud **50** is extremely important in that it controls air as it moves into the rotor blades **19** and similarly controls the air as it moves from the blades **19**. Utilizing the shroud **50**, the power absorbed by the rotor through the medium of the blades **19** is directly proportional to the percentage of the blade area left exposed by the shroud in any one instance. Thus, the amount of heat introduced in gas as it passes the rotor blades **19** is directly proportional to the position of the shroud. For example, when the shroud **50** is positioned to expose one-half of the blades **19**, the power absorbed is approximately one-half and the amount of heat introduced in the passing gas is approximately one-half as that which would be introduced if the shroud were fully open. In the absence of the inner wall **51** of the shroud at the entrance to the blades **19**, the inlet area to the rotor blades **19** would be larger than the exit area defined between the projected extremity of the outer wall **51** and the roots of the blade **19**. This means the radial velocity of the gas at the entrance to the blades **19** would be substantially less than its radial velocity in leaving the blades **19** and moving past the shielding wall **51** on their outer side. The net result is a change in direction of flow relative to the rotor blades, a turbulence and separation of the flow from leading edge portions of the rotor blades **19** as the gas moves thereby, and an irregularity in the gas flow. The total effect is unbalance of the rotor blades with corresponding fatigue and the production of undesirable noise and screeching. Thus, it should be clearly evident that the use of shielding interposed between the blades **19** and the stator blades **20** as well as between the blades **19** and the stator blades **21** and the nature of such control is extremely important. In the absence of a balanced movement of air through the rotor blades **19**, there is a loss in heating efficiency and a consequent deterioration of heater structure.

The embodiment last described is optimal since it enables a fully controlled recirculation of air or other gas used for heating purpose, a balanced control of power absorption by the rotor unit and thereby of the increment of heat added to the air as it flows by the radial blades **19**

and a production of static pressure to an extent to cause recirculation to be effected with high speed and in amounts to overcome frictional resistance in the heater structure per se. Not only can the heater unit such as described be precisely controlled but it is quite economical to fabricate and reaches its designed operating efficiency in a matter of seconds after starting.

The basic aspects of the invention above described should make it clearly evident that they contemplate both economy and efficiency in the art.

From the above description it will be apparent that there is thus provided a device of the character described possessing the particular features of advantage before enumerated as desirable, but which obviously is susceptible of modification in its form, proportions, detail construction and arrangement of parts without departing from the principle involved or sacrificing any of its advantages.

While in order to comply with the statute the invention has been described in language more or less specific as to structural features, it is to be understood that the invention is not limited to the specific features shown, but that the means and construction herein disclosed comprise but one of several modes of putting the invention into effect, and the invention is therefore claimed in any of its forms or modifications within the legitimate and valid scope of the appended claims.

Having thus described my invention, I claim:

1. A gas heater comprising, a housing, a plurality of rows of spaced blades in said housing arranged in spaced following relation and occupying a generally common plane, means in said housing defining a continuous flow path, a limited portion of which is occupied by said spaced following blades, means defining an inlet opening directly to said flow path, means defining limited outlet from said flow path, one row of said blades having means in connection therewith for drive thereof relative the other blades to produce a continuing recirculation of the gas in said housing through said flow path, said one row of blades being adapted to add an additional increment of heat to said gas in each pass thereby, said outlet providing means for a fractional discharge therethrough of the so heated gas, said one row of blades influencing a fractional input of gas to said flow path by way of said inlet to mix with recirculated gas in an amount which is substantially equal in proportion to that amount discharged through said outlet.

2. A gas heater comprising, a shell-like housing having a gas inlet, means for drawing gas through said inlet and imparting an angular velocity to the gas within said housing to thereby raise its temperature, means for limited discharge of the heated gas from said housing, means defining a continuous path for continuing recirculation within said housing of heated gas not discharged, said velocity imparting means occupying a limited portion of said path and arranged to impart additional heat to said gas in each pass thereby, and means in said path for converting said angular velocity to a static pressure and producing a high speed recirculation of the heated gas.

3. A gas heater comprising, a housing, a plurality of rows of spaced blades, a continuous flow path in said housing, a limited portion of which is occupied by said blades, said flow path being otherwise relatively unobstructed, means defining a gas inlet in direct communication with said flow path, means defining an outlet from said flow path, one of said rows having means in connection therewith for drive thereof relative the other blades to create a continuing cyclic recirculation of a gas through said flow path and to add an increment of heat thereto in each pass of the gas thereby, said outlet providing means for discharge of a fractional portion of the heated gas in each cycle thereof through said path, said inlet providing for inflow of supplemental gas under the influence of the driven blades in a relatively non-turbulent flow and in amounts substantially equal in proportion to that discharged and means to control a cross-sectional area of said flow path and thereby control the increment of heat added to the gas in each pass thereof through said one row of blades.

4. A gas heater comprising, a housing, a plurality of rows of spaced blades in spaced following relation within said housing occupying a generally common plane, means defining a continuous flow path in said housing, a limited portion of which is occupied by said blades, means for introducing gas to said path in a non-turbulent flow, means defining an outlet from said flow path, one of said rows of blades having means for drive thereof relative the other blades to create a continuing recirculation of a gas through said flow path and to add an increment of heat thereto in each pass of the gas thereby, said outlet providing means for a limited delivery of heated gas therethrough, said gas introduced to said flow path being substantially equal in proportion to that discharged through said outlet and the row of blades immediately preceding said outlet being fixed to convert a portion of the energy induced in the gas on movement thereof by said one row of blades to a static pressure which induces a high speed recirculation of the heated gas not discharged from said flow path.

5. A gas heater or the like comprising, a housing, a first row of spaced stator blades therein, a second row of spaced stator blades in said housing in following relation to said first row, a third row of blades interposed between said rows of stator blades for movement relative thereto, means in said housing defining a continuous flow path, a portion of which is occupied by said blades, an inlet for delivery of gas to said housing, said relatively moving blades being operative to draw gas from said inlet and through said first row of said stator blades and drive the gas through said second row of stator blades, means defining an outlet for a portion of the gas heated thereby, said second row of stator blades providing means for continuous high speed recirculation of the remaining heated gas, said heater providing for limited inflow of additional gas to said housing to replace the gas discharged, thereby enabling a volume of gas to be recirculated in said housing which is many times greater than the charge of gas introduced thereto and discharged therefrom.

6. A gas heater as set forth in claim 5 characterized by the said rows of blades occupying a generally common plane.

7. A gas heater as set forth in claim 6 and means operatively related to said third row of blades to variably function in response to a selective demand of heat from said heater to control the power absorbed by the blades in said third row on movement thereof through said flow path and thereby control the heat induced in the gas.

8. A gas heater as set forth in claim 7 wherein said last named means includes shield means positioned adjacent said third row of blades.

9. A gas heater comprising a housing having an inlet and an outlet, a rotor in said housing including a plurality of arcuately arranged relatively spaced blades of relatively short radial length, means for driving said rotor, means providing a flow path in said housing interconnecting the output and inlet sides of said rotor blades, said housing inlet being disposed to deliver a relatively non-turbulent flow of gas to said flow path in advance of the inlet side of said rotor blades and said housing outlet being in the vicinity of the output side of said rotor blades and providing for a fractional delivery therethrough of gas discharged from said rotor blades and means following said rotor blades operative to convert angular velocity in the gas discharged therefrom to pressure to a degree to influence the balance of the heated air not discharged to recirculate through the flow path at a high speed.

10. A gas heating device including, a housing having an inlet and an outlet, an annular body fixed in said

housing generally concentric to said inlet, a rotor in said housing opposite said inlet and to one side of said annular body, said rotor mounting radially oriented blades adjacent one side of said annular body remote from said inlet, stator blades fixed in spaced relation to either side of said rotor blades, shield means adapted to form a wall to either side of said rotor blades in immediately adjacent relation thereto, temperature control means connected with said shield means and adapted to automatically adjust said shield means relative said rotor blades and means in said outlet to selectively limit the discharge of gas therethrough, said heater unit providing means for a continuing recirculation of a major portion of the gas therein to cyclically increase its temperature and cyclically discharge a limited portion thereof through said outlet, said rotor being operative to draw replacement gas through said inlet to the extent gas is discharged through said outlet.

11. A gas heater as set forth in claim **10** characterized by the blades in advance of said rotor blades being formed to cause gas moving thereby to be discharged to said rotor blades in a direction opposite to the rotor blade movement and said blades following said rotor blades being arranged to convert the angular velocity in the gas delivered thereto to static pressure to create a high speed recirculation of the gas delivered therethrough.

12. A gas heater comprising a housing having an inlet and an outlet, a bladed rotor in said housing, said inlet providing means for said rotor to draw gas to said housing in a relatively non-turbulent flow, means in connection with said rotor for drive thereof to cause its blades to pick up, drive and add an increment of heat to the gas in said housing, said outlet providing means for limited discharge of heated gas from said housing and means interposed in the path of heated gas discharged from said rotor operative to induce at least a portion of the heated gas to recirculate to said rotor at a high speed, said housing providing means determining the recirculating path.

13. A gas heater as set forth in claim **12** characterized by means within said housing for controlling the exposure of the driven rotor blades and thereby controlling the increment of heat added to gas in movement thereof by the blades.

14. A gas heater or the like comprising, a shell-like housing, a flow path in said housing, a plurality of rows of spaced blades positioned in axially spaced following relation within said flow path, said flow path being continuous and a limited portion thereof being occupied by said blades, said housing having means defining a gas inlet which opens directly to a portion of said flow path, said housing having means providing for outflow from said flow path, means in said housing mounting at least one of said rows of blades for drive thereof relative the other blades, said one row being in direct communication with said inlet and being operative to continuously draw gas therethrough and repeatedly recirculate a major portion thereof through said flow path, adding an additional increment of heat thereto in each pass of the gas thereby, said means providing for outflow providing for a limited outflow from said housing of the so-heated gas in each pass thereby and said inlet providing for limited input of gas to said flow path in amount substantially equal to the amount of gas discharged through said outlet.

15. A gas heater including, a housing, means for inducing gas in said housing to move in a continuous flow path, said means being arranged to impart an increment of heat to the gas during each cycle of movement thereof through said flow path, means providing for a limited discharge from said housing of a portion of the so heated gas during each cycle thereof through said flow path, means in said flow path inducing the cyclic movement of said gas to occur at a high speed, means defining a limited inlet to said housing opening directly to said flow path, said heating means being operative to induce a relatively non-turbulent inflow of gas to said flow path by way of said inlet, said inflow being proportional to the amount of gas discharged through said outlet and means in said housing for controlling the angular momentum of the gas circulating through said flow path to limit the temperature of the gas discharged from said housing.

16. A gas heater comprising, a housing, a plurality of rows of spaced blades in spaced following relation within said housing occupying a generally common plane, means defining a continuous flow path in said housing, a portion of which is occupied by said blades, means for introducing gas to said path in a non-turbulent flow, means defining an outlet from said flow path, one of said rows of blades having means for drive thereof relative the other blades to create a continuing recirculation of a gas through said flow path and to add an increment of heat thereto in each pass of the gas thereby, said outlet providing means for a limited delivery of heated gas therethrough, said inlet providing for limited input of gas to said flow path substantially equal in proportion to that discharged through said outlet and the row of blades immediately preceding said outlet being fixed to convert a portion of the energy induced in the gas on movement thereof by said one row of blades to a static pressure which induces a high speed recirculation of the heated gas not discharged from said flow path, and a row of blades fixed in said flow path in said housing immediately in advance of and spaced from said one driven row of blades and arranged to direct gas moving thereby to the blades in said one driven row in a direction opposite to the direction of their movement to increase the power absorption thereby and proportionally increase the increment of heat added to the gas in moving through said one driven row of blades.

17. A gas heater as in claim **16** characterized by sealing means having a selective projection in said flow path to limit the delivery of gas to and through the said row of blades immediately preceding said outlet.

18. A gas heater comprising a housing having an inlet opening, a rotor in said housing at a side thereof remote from and accessible to said opening, said rotor being in alignment with said opening and mounting projected, relatively spaced blades in connection therewith, means in connection with said rotor for drive thereof to move the gas in said housing through a continuous flow path, said flow path being in a sense transverse to the face of said rotor accessible to said inlet opening, said housing having an outlet opening for limited outflow of gas from said flow path, said blades in connection with said rotor being operable on drive thereof to repetitively recirculate the gas in said housing through said flow path to add an increment of heat thereto in each pass of the gas thereby, said outlet providing for limited outflow of heated gas and the said blades being operable to draw replacement gas to said flow path by way of said inlet opening and further blade means in said housing positioned in a limited portion of said flow path and cooperatively related to said rotor mounted blades to induce the recirculation of gas in said housing to occur at a relatively high speed and thereby facilitate a rapid rise in the temperature of the gas in said housing.

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