Feb. 9, 1971 W. F. JACKSON ETAL 3,561,901

HEATING APPARATUS

Filed Dec. 20, 1968 2 Sheets-Sheet 1

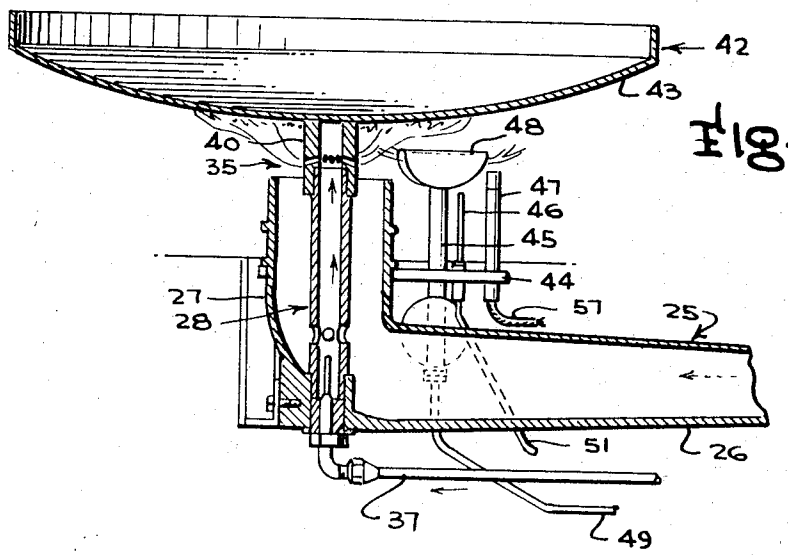


Fig-3

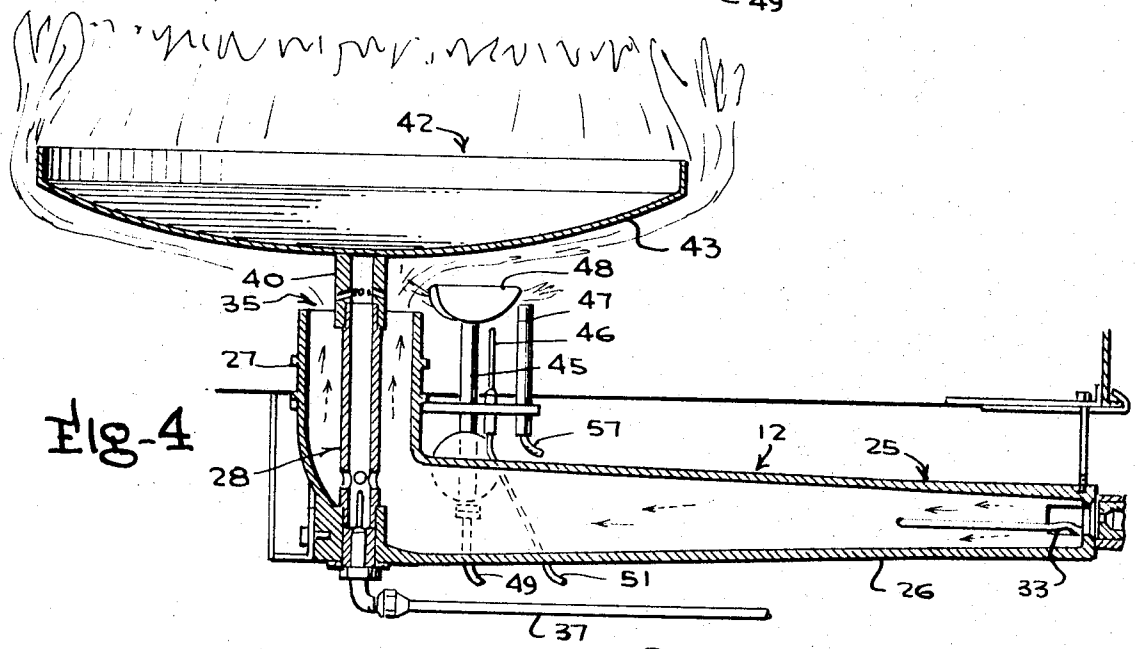


Fig-4

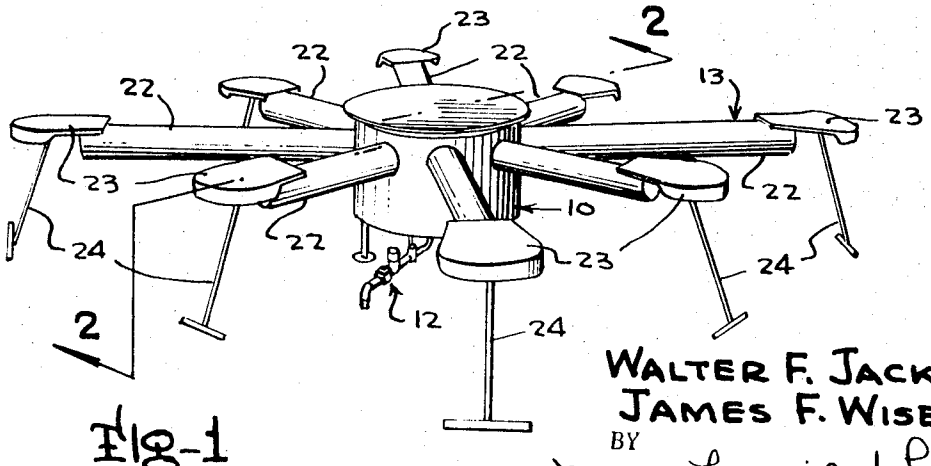


Fig-1

INVENTORS

WALTER F. JACKSON &
JAMES F. WISE

BY

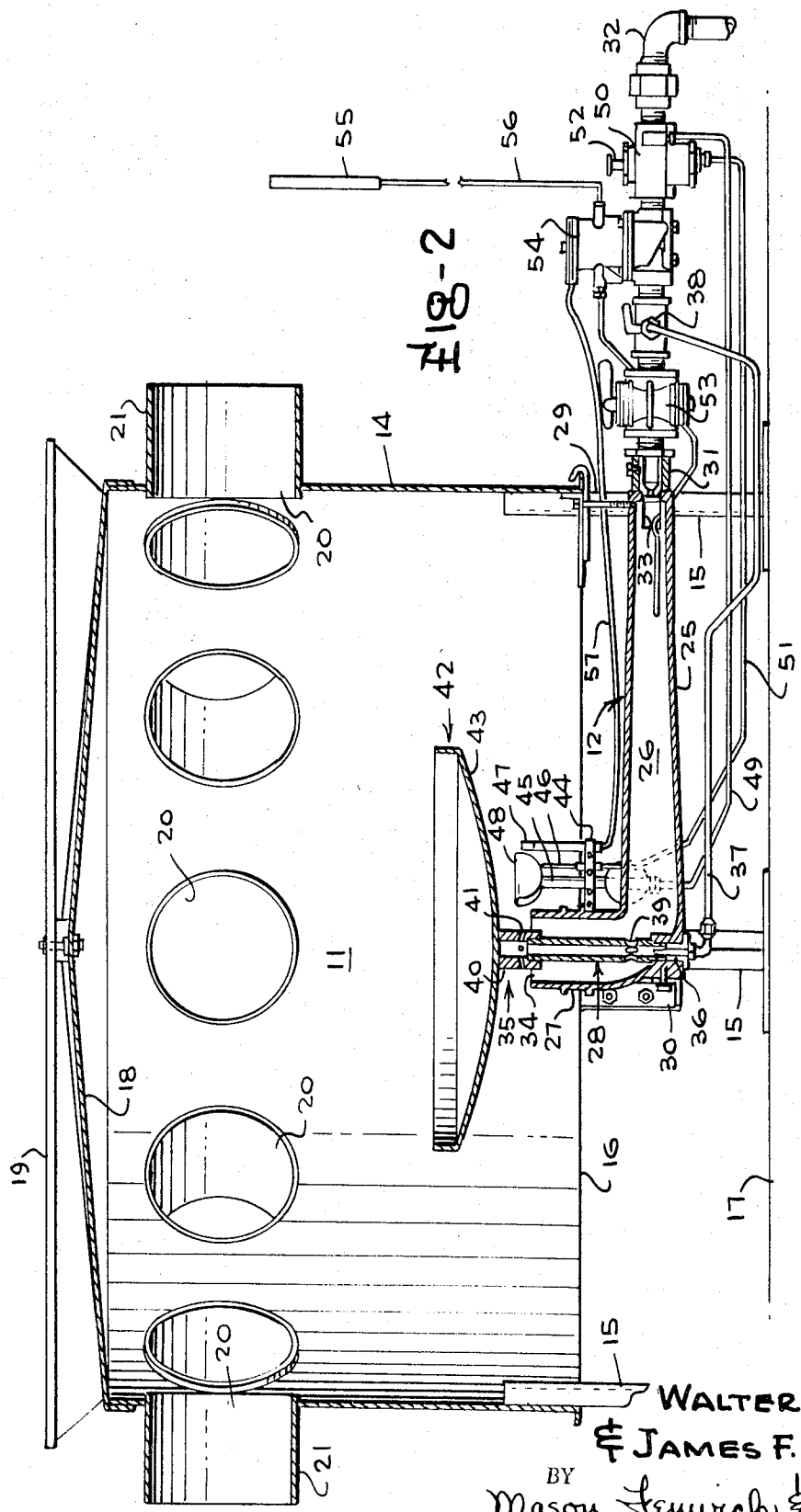
Mason, Fenwick & Lawrence

ATTORNEYS

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HEATING APPARATUS

Filed Dec. 20, 1968 2 Sheets-Sheet 2



INVENTORS
WALTER F. JACKSON
& JAMES F. WISE
BY
Mason, Fenwick & Lawrence
ATTORNEYS

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3,561,901

HEATING APPARATUS

Walter F. Jackson and James F. Wise, Clinton, N.C., assignors to Vann Industries, Incorporated, Clinton, N.C., a corporation of West Virginia

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ABSTRACT OF THE DISCLOSURE

A heating apparatus including enclosure means defining a combustion chamber, means for distributing heated air from said combustion chamber, and a burner unit disposed in said combustion chamber comprising a first venturi having an inlet port and an outlet port partially defining a combustion zone, the first venturi having at least one primary air intake port, a first fuel supply line communicating with the inlet port of the first venturi, a second venturi mounted on the first venturi having an inlet port and at least one outlet port communicating with the combustion zone, the second venturi having at least one primary air intake port directly communicating with the interior of the first venturi, a second fuel supply line communicating with the inlet port of the second venturi, and the first venturi having a larger capacity than the second venturi whereby the second venturi may be operated to provide a low firing rate and the first venturi may be operated with or without the second venturi to provide higher firing rates.

This invention relates to a novel heating apparatus and more particularly to a heating apparatus adapted for curing tobacco. This invention further contemplates a novel burner unit for a heating apparatus operable to provide different firing rates.

In the curing of tobacco, the primed tobacco leaves commonly are cured by placing them in tobacco barns and subjecting the tobacco leaves to heated air at predetermined temperatures and for predetermined periods of time. Initially, the tobacco leaves are subjected to heated air in the temperature range of 90 to 100° F. for a period of about 30 to 60 hours. This first stage of the curing cycle causes the leaves to undergo a physiological transformation, during which the starch and protein molecules of the leaves are chemically converted, and the chlorophyll in the leaves is oxidized, causing the leaves to turn yellow. This first stage commonly is referred to as the yellowing stage. Upon completion of the yellowing stage the temperature of the heated air is increased to the range of 130 to 135° F. and held in such range for a period of approximately 20 to 30 hours. During this second stage of the curing cycle, the physiological transformation or yellowing of the tobacco leaves is halted and the leaves are dehydrated.

In the prior art there are numerous types of heating apparatus for curing primed tobacco leaves. It has been found, however, that most of the heating apparatus in the prior art is not entirely satisfactory in performance and safe in operation.

Accordingly, it is the principal object of this invention to provide a novel heating apparatus.

Another object of this invention is to provide a novel heating apparatus for curing tobacco leaves.

A further object of this invention is to provide an improved heating apparatus for curing tobacco leaves, which is adapted to provide different heat outputs.

A still further object of the present invention is to provide an improved heating apparatus for curing tobacco leaves, which is adapted to provide a relatively low heat output suitable for the yellowing stage in the tobacco curing cycle and a relatively high heat output suitable for the dehydration stage of the tobacco curing cycle.

Another object of the present invention is to provide a novel heating apparatus particularly adapted for curing tobacco leaves, which is comparatively simple in construction, effective in performance and safe in operation.

A further object of the present invention is to provide a novel burner unit.

A still further object of the present invention is to provide a novel burner unit for a heating apparatus suitable for curing tobacco leaves.

Another object of the present invention is to provide a novel burner unit having high and low firing rates.

A further object of the present invention is to provide a novel burner unit, which is simple in construction, and efficient and safe in operation.

Other objects and advantages of the present invention will become more apparent to those persons skilled in the art to which the present invention pertains, from the following description taken in conjunction with the accompanying drawings, wherein:

FIG. 1 is a perspective view of an embodiment of the invention;

FIG. 2 is an enlarged cross-sectional view taken along line 2—2 in FIG. 1;

FIG. 3 is an enlarged vertical cross-sectional view of a portion of the burner unit utilized in the embodiment shown in FIGS. 1 and 2, illustrating the burner unit operating at a low firing rate; and

FIG. 4 is a vertical cross-sectional view of the burner unit included in the heating apparatus shown in FIGS. 1 and 2, illustrating the burner unit operating at a higher firing rate.

Briefly described, the present invention relates to a heating apparatus generally including an enclosure means defining a combustion chamber, means for distributing heated air from the combustion chamber, and a burner unit disposed in said combustion chamber comprising a first venturi including a horizontal section having an inlet port and at least one primary air intake opening, and a vertical section having an outlet port partially defining a combustion zone, a first fuel supply line communicating with the inlet port of the first venturi, a second venturi mounted in the vertical section of the first venturi having an inlet port and at least one outlet port communicating with the combustion zone, the second venturi having at least one primary air intake port directly communicating with the interior of the first venturi, a second fuel supply line communicating with the inlet port of the second venturi, and the first venturi having a larger capacity than the second venturi whereby the second venturi may be operated to provide a low firing rate and correspondingly produce a predetermined low heat output, and the first venturi may be operated with or without the second venturi to provide higher firing rates and correspondingly to produce predetermined higher heat outputs

Referring to the drawings, there is illustrated an embodiment of the invention. The embodiment generally includes an enclosure unit **10**, defining a combustion chamber **11**, a burner unit **12** mounted below and partially within the combustion chamber **11**, and a heat distribution system **13** for distributing the heated air emanating from the combustion chamber **11**. The enclosure unit **10** consists of a circular wall membr **14** which is supported on a plurality of leg members **15** so that the bottom edge **16** thereof is disposed in spaced relation to the floor surface **17**, and a cover member **18** closing the upper end thereof. Mounted on the cover member **18** is a cover or shield member **19**. The upper end of the wall member **14** is provided with a plurality

of outlet ports **20** about the circumference thereof, which are provided with tubular mounting ducts **21**. Each of the mounting ducts is disposed substantially radially relative to the vertical axis of the circular wall member **14**.

The heat distribution system **13** comprises a plurality of elongated tubular duct members **22** mounted on the mounting duct members **21** and extending radially to points adjacent the side walls of the housing structure in which the heating apparatus is located. Each of the duct members **22** is provided with a baffle member **23** mounted on the end thereof. Each duct member **22** and its associate baffle member **23** is supported at its outer end by a leg member **24**. It will be appreciated that the lengths of the tubular duct members **22** can be varied to provide the desired distribution of heated air emanating from the combustion chamber **11**.

As best illustrated in FIG. 2, the burner unit **12** generally includes a first venturi **25** having a horizontal section **26** and a vertical section **27**, and a vertically disposed venturi **28** mounted in the vertical section **27** of venturi **25**. The venturi **25** is supported on a pair of brackets **29** and **30** suspended from the circular wall **14** of the enclosure unit, so that the horizontal section **26** of the venturi **25** will be disposed below the lower edge of the circular wall **14** and radially relative to such wall, and the vertical section **27** of venturi **25** will be disposed substantially axially relative to the circular wall **14** and will extend into the lower end of the combustion chamber **11**.

The venturi section **26** includes an orifice **31** having an inlet port communicating with a fuel supply line **32** and primary air intake ports **33** disposed adjacent the orifice **31**. The venturi section **27** communicates directly with the venturi section **26**, and is provided with an outlet opening **34** partially defining and communicating with a combustion zone **35**. In normal operation, fuel and primary air introduced into venturi **25** through orifice **31** and primary air intake ports **33** are mixed and ejected through outlet port **34** into combustion zone **35**, where the fuel-air mixture combines with secondary air and is ignited.

The venturi **28** is disposed coaxially relative to the venturi section **27**, and is mounted in a bottom wall portion thereof. The venturi **28** is provided with an orifice **36** having an inlet port communicating with a fuel supply line **37** connected to the main fuel supply line **32**, having a manually operated shut-off valve **38**. The lower end of the venturi **28** also is provided with a plurality of primary air intake ports **39** which communicate directly with the interior of the venturi **25**. The venturi **28** further is provided with an adapter **40** at the upper end thereof. The adapter **40** is substantially cylindrical in configuration and is provided with a plurality of radial burning ports **41** communicating with the combustion zone **35**. Mounted on the upper end of the venturi **28** is a baffle member **42** having a convex bottom surface **43** disposed adjacent the combustion zone **35**. In normal operation, fuel and air introduced into the venturi **28** through orifice **36** and primary air intake ports **39** will mix as they traverse the length of the venturi **28** and will be ejected through burner ports **41** where the air-fuel mixture combines with secondary air and is ignited. The flames emanating from the combustion zone **35** will be diverted radially by the conically configured bottom surface **43** of the baffle **42** and heat the air in the combustion chamber **11**.

The venturi section **27** also is provided with a bracket **44** on which there is mounted a pilot burner **45**, a thermocouple **46**, and a termoelectric generator **47**. The pilot burner **45** is provided with a diverter baffle **48** which is adapted to divert the flame of the pilot burner toward the combustion zone **35** to ignite fuel-air mixtures emanating either from outlet port **34** of venturi **25**, or burner ports **41** of venturi **28**. The pilot burner **45** is provided

with a fuel supply line **49** which is connected to a pilot safety valve **50** mounted in the main fuel supply line **32**. The thermocouple **46** is disposed in heat transfer relation to the flame of the pilot burner **45** and is electrically connected to the pilot safety valve **50** by means of an electrical line **51**. The pilot safety valve **50** is of the type that is normally in the closed position which prevents the flow of fuel through the main supply line **32** and the pilot burner fuel supply line **49**. The valve **50** is opened by depressing a reset plunger **52** and normally will remain open only when the plunger **52** is depressed, unless the pilot burner is lit and the thermocouple **46** is heated by the flame of the pilot burner to generate an electrical current in line **51** to retain the valve **50** in the open position.

The main fuel supply line **32** also is provided with a manual shut-off valve **53** and a thermostatically controlled valve **54**. The thermostatically controlled valve **54** is connected to a thermostat **55** by means of an electrical lead line **56** and is operable responsive to the thermostat. The valve **54** also is connected to the thermoelectric generator **47** disposed in heat transfer relation with the flame of the pilot burner **45**, by means of an electrical lead line **57**. In addition to being operative responsive to the thermostat **55**, the valve **54** is operable responsive to the operation of the thermoelectric generator **49**, whereby the valve **54** will remain open only so long as the pilot burner **45** is lit and heat is being generated to the thermoelectric generator **47**. It will be understood that the heat generated by the pilot burner will generate a current in the thermoelectric generator **47** sufficient to actuate the valve **54** into the open position.

When the heating apparatus as described is in the non-operating condition, the pilot safety valve **50**, the thermostatically controlled valve **54**, the pilot burner supply line shut-off valve **38**, and the main fuel supply shut-off valve **53** are all in the closed positions. When it is desired to operate the heating apparatus to provide a comparatively low heat output, such as is required during the yellowing stage in the curing cycle of tobacco leaves, the thermostat **55** is set at the appropriate temperature and the burner unit is then set to be lit off. To light off the burner unit, the plunger **52** of the pilot safety valve **50** is depressed so that fuel will flow through fuel supply line **49** to the pilot burner **45**. The pilot burner is then lit off while the plunger **52** is maintained in the depressed position. After the pilot burner has been burning for a short period of time, sufficient heat will be generated to activate the thermocouple **46** which generates a voltage sufficient to retain the plunger **52** in the depressed position and correspondingly, maintain the valve **50** in the open position. The temperature differential in the thermostat **55**, and the current generated by the thermoelectric generator **47** will cause the control valve **54** to open. The venturi **28** then can be operated by opening the shut-off valve **38**. As soon as this is accomplished, fuel will flow through fuel supply line **37** and be introduced through the orifice **36** into venturi **28** where it will be mixed with primary air introduced through inlet ports **39**. As the fuel-air mixture is ejected through burner ports **41** into combustion zone **35**, it will be ignited by the pilot burner flame. The flame emanating from the combustion zone **35** will engage the convex surface **43** of baffle **42** and be diverted radially to heat the air in the combustion chamber **11**, as illustrated in FIG. 3. The burner unit will then continue to operate at a low firing rate as long as the valve **54** remains open. As previously mentioned, the valve **54** will remain open unless the pilot burner becomes extinguished or the temperature of the area being heated exceeds the temperature setting of the thermostat **55**.

When it is desired to operate the burner unit at a higher firing rate to produce a higher heat output as desired during the dehydration stage in the curing cycle of tobacco, the temperature setting of the thermostat **55** is advanced to a higher reading and the valve **53** is opened

to supply fuel to the venturi **25**. Fuel introduced into the venturi **25** through orifice **31** and primary air introduced through intake ports **33** mixes as it traverses through venturi **25**, and is ejected through outlet port **34** into combustion zone **35** where it mixes further with secondary air and is ignited by the flame of pilot burner **45**. The flame emanating from the venturi **25** also engages the concave surface **43** of baffle **42** and is diverted radially to heat the air in the combustion chamber **11**, as illustrated in FIG. 4.

It will be appreciated that the venturi **28** can be operated alone to provide a low firing rate, the venturi **25** can be operated to provide an intermediate firing rate, or the venturi **25** and **28** can be operated simultaneously to provide a high firing rate. This can be accomplished simply by setting the thermostat to the appropriate temperature reading and adjusting the shut-off valves **38** and **53**. With the appropriate thermostat settings, the burner can be operated at a low firing rate by opening the valve **88** and closing the valve **53**, at an intermediate firing rate by closing the valve **38** and opening the valve **53**, and at a high firing rate by opening both valves **38** and **53**.

The thermocouple **46** and the thermoelectric generator **47** provide a maximum safe operation of the heating apparatus, in that upon extinguishment of the pilot burner, voltages will be generated by the thermocuple **46** and the thermoelectric generator **47** to close safety pilot valve **50** and control valve **54**.

The heated air in the combustion chamber **11** will flow through the openings **20** in circular wall **14** of the enclosure unit, and through the tubular duct members **22** to be distributed to various parts of the housing structure being heated. The temperature of the housing structure being heated is controlled by the thermostat **55**. Cold air in the housing structure will descend and be drawn through the lower open end of the enclosure unit **10** to be heated by the burner unit **12** and recirculated through the distribution system **13**.

Having thus described an embodiment of our invention, we claim:

1. A heating apparatus comprising enclosure means defining a combustion chamber, means for distributing heated air from said combustion chamber, and a burner unit disposed in said combustion chamber comprising a first venturi having an inlet port and an outlet port at least partially defining a combustion zone, said first venturi having at least one primary air intake port, a first fuel supply line communicating with the inlet port of said first venturi, a second venturi mounted on said first venturi having an inlet port and at least one outlet port communicating with said combustion zone, said second venturi having at least one primary air intake port directly communicating with the interior of said first venturi, a second fuel supply line communicating with the inlet port of said second venturi, and said first venturi having a larger capacity than said second venturi whereby said second venturi may be operated to provide a low firing rate and correspondingly produce a predetermined low heat output and said first venturi may be operated with or without said second venturi to provide higher firing rates and correspondingly to produce predetermined higher heat outputs.

2. A burner unit comprising a first venturi having an inlet port and an outlet port at least partially defining a combustion zone, said first venturi having at least one primary air intake port, a first fuel supply line communicating with the inlet port of said first venturi, a second venturi mounted on said first venturi having an inlet port and at least one outlet port communicating with said combustion zone, said second venturi having at least one primary air intake port directly communicating with the interior of said first venturi, a second fuel supply line communicating with the inlet port of said second venturi, and said first venturi having a larger capacity than said second venturi whereby said second venturi may be operated to provide a low firing rate and correspondingly to produce a predetermined low heat output and said first venturi may be operated with or without said second venturi to provide higher firing rates and correspondingly to produce predetermined higher heat outputs.

3. A burner unit according to claim **2**, including a baffle for spreading the flame emanating from said first and second venturi during operation of the burner unit.

4. A burner unit according to claim **2**, including a pilot burner disposed adjacent said combustion zone for igniting fuel-air mixtures emanating from the outlet ports of said venturi.

5. A burner unit according to claim **4**, including a fuel supply line for said pilot burner, a safety valve in said fuel supply lines for venturi, a thermocouple disposed in heat transfer relation with said pilot burner, and said safety valve being operable responsive to the operation of said thermocouple.

6. A burner unit according to claim **2**, including a thermostatically controlled valve disposed in said fuel supply lines for said venturi.

7. A burner unit according to claim **4**, including a thermostatically controlled valve disposed in the fuel supply lines of said venturi and a thermoelectric generator disposed in heat transfer relation with said pilot burner operable to close said thermostatically controlled valve upon extinguishment of said pilot burner.

8. A burner unit according to claim **2**, including a baffle for spreading the flame emanating from said first and second venturi during operation of the burner unit, a pilot burner disposed adjacent said combustion zone for igniting fuel-air mixtures emanating from the outlet ports of said venturi, a fuel supply line for said pilot burner, a safety valve in said fuel supply lines for said venturi, a thermocouple disposed in heat transfer relation with said pilot burner operable to close said safety valve upon extinguishment of said pilot burner, and a thermostatically controlled valve disposed in said fuel supply lines for said venturi.

9. A heating apparatus comprising enclosure means defining a combustion chamber, means for distributing heated air from said combustion chamber, and a burner unit disposed in said combustion chamber comprising a first venturi including a horizontal section having an inlet port and at least one primary air intake port, and a vertical section having an outlet port at least partially defining a combustion zone, a first fuel supply line communicating with the inlet port of said first venturi, a second venturi vertically mounted in the vertical section of said first venturi having an inlet port and at least one outlet port communicating with said combustion zone, said second venturi having at least one primary air intake port directly communicating with the interior of said first venturi, a second fuel supply line communicating with the inlet port of said second venturi, and said first venturi having a larger capacity than said second venturi whereby said second venturi may be operated to provide a low firing rate and correspondingly produce a predetermined low heat output and said first venturi may be operated with or without said second venturi to provide higher firing rates and correspondingly to produce predetermined higher heat outputs.

10. A burner unit comprising a first venturi, including a horizontal section having an inlet port and at least one primary air intake port, and a vertical section having an outlet port at least partially defining a combustion zone, a first fuel supply line communicating with the inlet port of said first venturi, a second venturi vertically mounted in the vertical section of said first venturi having an inlet port and at least one outlet port communicating with said combustion zone, said second venturi having at least one primary air intake port directly communicating with the interior of said first venturi, a second fuel supply line communicating with the inlet port of said second venturi, and said first venturi having a larger capacity than said

second venturi whereby said second venturi may be operated to provide a low firing rate and correspondingly to produce a predetermined low heat output and said first venturi may be operated with or without said second venturi to provide higher firing rates and correspondingly to produce predetermined higher heat outputs.

11. A burner unit according to claim **10**, including a baffle for spreading the flame emanating from said first and second venturi during operation of the burner unit.

12. A burner unit according to claim **10**, including a pilot burner disposed adjacent said combustion zone for igniting fuel-air mixtures emanating from the outlet ports of said venturi.

13. A burner unit according to claim **12**, including a fuel supply line for said pilot burner, a safety valve in said fuel supply lines for said venturi and a thermocouple disposed in heat transfer relation with said pilot burner operable to close said safety valve upon extinguishment of said pilot burner.

14. A burner unit according to claim **10**, including a thermostatically controlled valve disposed in said fuel supply lines for said venturi.

15. A burner unit according to claim **12**, including a thermostatically controlled valve disposed in the fuel supply lines of said venturi and a thermoelectric generator

disposed in heat transfer relation with said pilot burner operable to close said thermostatically controlled valve upon extinguishment of said pilot burner.

16. A burner unit according to claim **10**, including a baffle for spreading the flame emanating from said first and second venturi during operation of the burner unit, a pilot burner disposed adjacent said combustion zone for igniting fuel-air mixtures emanating from the outlet ports of said venturi, a fuel supply line for said pilot burner, a safety valve disposed in the fuel supply lines of said first and second venturi, a thermocouple disposed in heat transfer relation with said pilot burner operative to close said safety valve upon extinguishment of said pilot burner, and a thermostatically controlled valve disposed in said fuel supply lines for said first and second venturi.

References Cited

UNITED STATES PATENTS

1,923,393	8/1933	Pickup	431—284
3,329,416	7/1967	Jackson	263—19

EDWARD G. FAVORS, Primary Examiner

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263—19