United States Patent [19]

Hart et al.

[11] **3,880,143**

[45] **Apr. 29, 1975**

[54] **COMBINATION FUME OXIDIZER AND ASPHALT HEATER**

[75] Inventors: **Wallace L. Hart**, Evanston; **Gordon D. Vevang**, Arlington Heights; **Herman J. Walkowicz**, Mount Prospect, all of Ill.

[73] Assignee: **U.I.P. Engineered Products Corporation**, Elk Grove Village, Ill.

[22] Filed: **Feb. 21, 1973**

[21] Appl. No.: **334,257**

[52] **U.S. Cl.** ..... **126/343.5 A**; 432/72; 110/8 A

[51] **Int. Cl.** **E01c 19/45**

[58] **Field of Search** ..... 126/343.5 R, 343.5 A; 432/8, 21, 23, 59, 72; 110/8 A

[56] **References Cited**

UNITED STATES PATENTS

2,750,680	6/1956	Houdry et al.	432/8 X
2,795,054	6/1957	Bowen	432/8 X
3,706,445	12/1972	Gentry	432/72
3,787,171	1/1974	Cromp	432/72

Primary Examiner—Meyer Perlin
Assistant Examiner—Ronald C. Capossela
Attorney, Agent, or Firm—Ronald E. Barry

[57] **ABSTRACT**

A combined fume oxidizer and asphalt heater which substantially reduces fumes normally associated with the production of asphalt roofing materials. These fumes are utilized to heat additional asphalt and are substantially combusted. A method is described wherein the fumes from an asphalt shingle saturation machine are directed through a burner of the gas or oil type and the combined streams of burned gases are utilized to heat asphalt material. The heat of combustion is controlled by a thermocouple and the temperature in the heating chamber by by-passing a portion of the combined combusted streams away from the heating chamber and into an exhaust duct to which the other portion of the combusted gases is directed after heating the asphalt material. A damper control means directs the portions of the combusted gases to the heating chamber or through the by-pass ducts depending upon the temperature desired in the heating chamber for heating the asphalt material.

18 Claims, 5 Drawing Figures

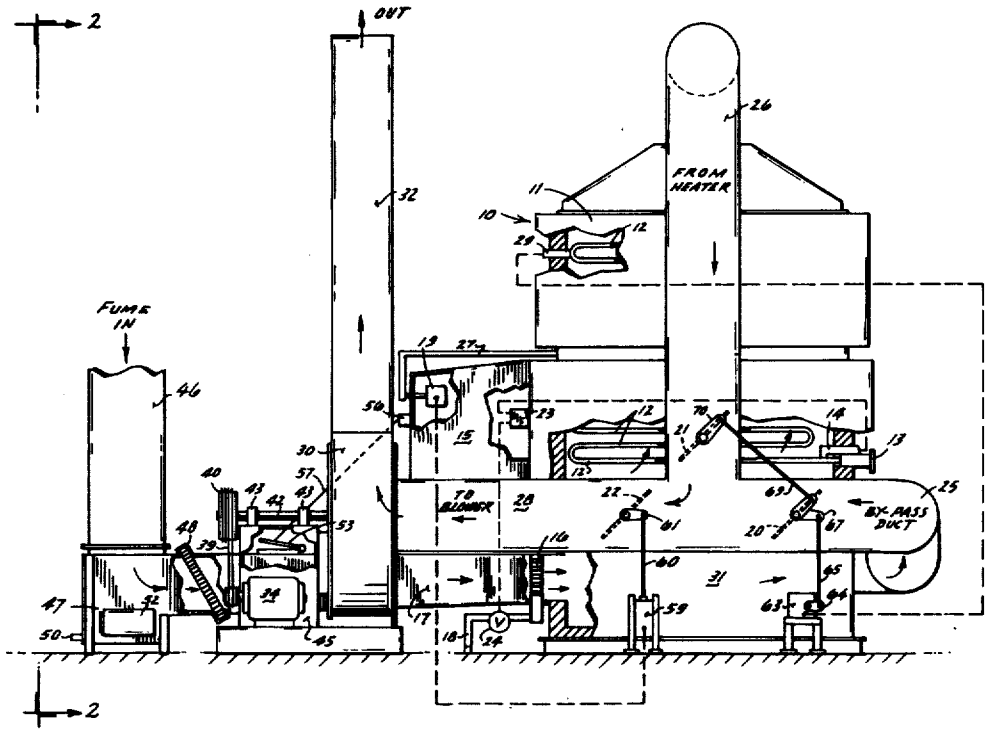
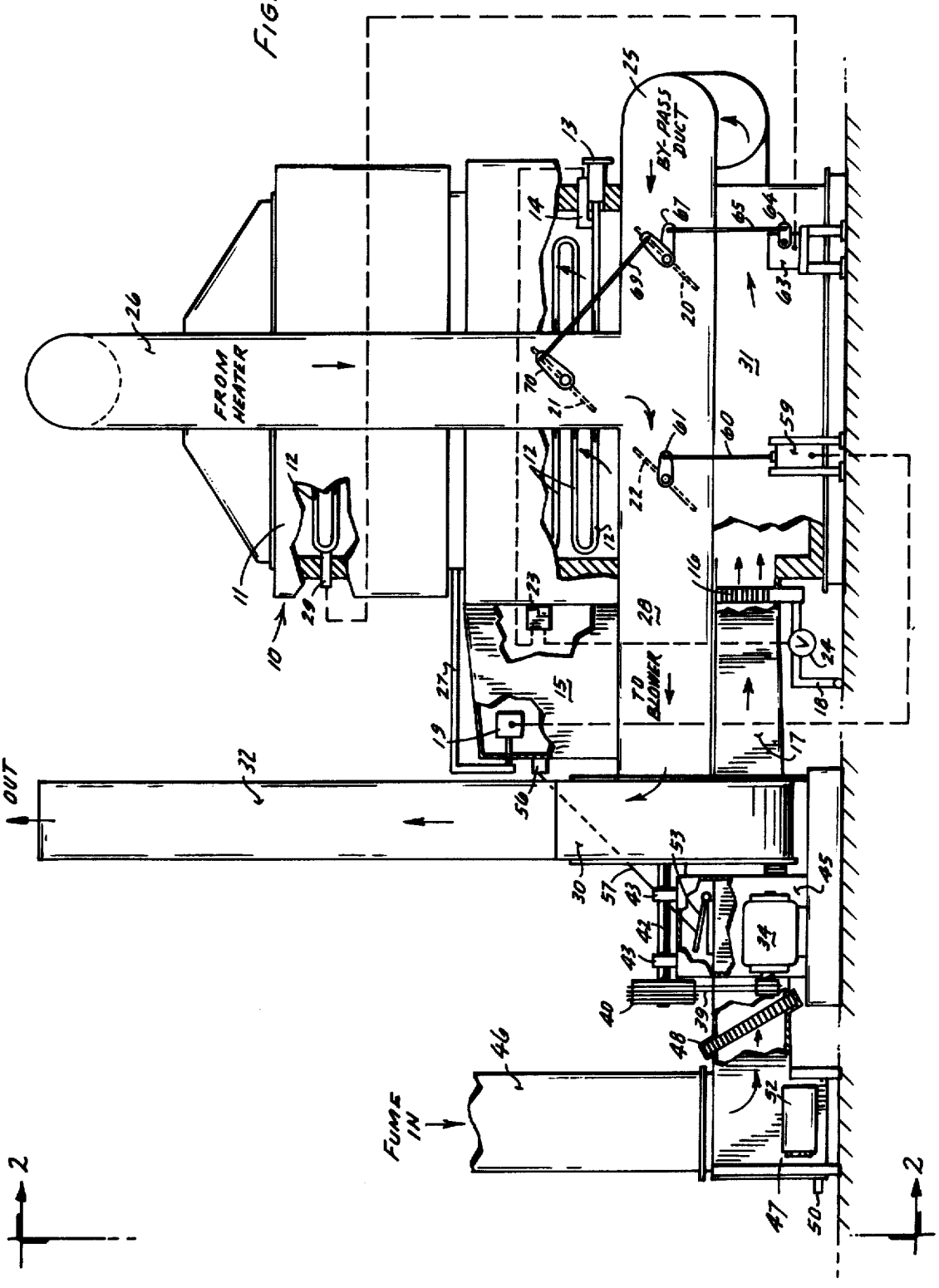


FIG. 1.



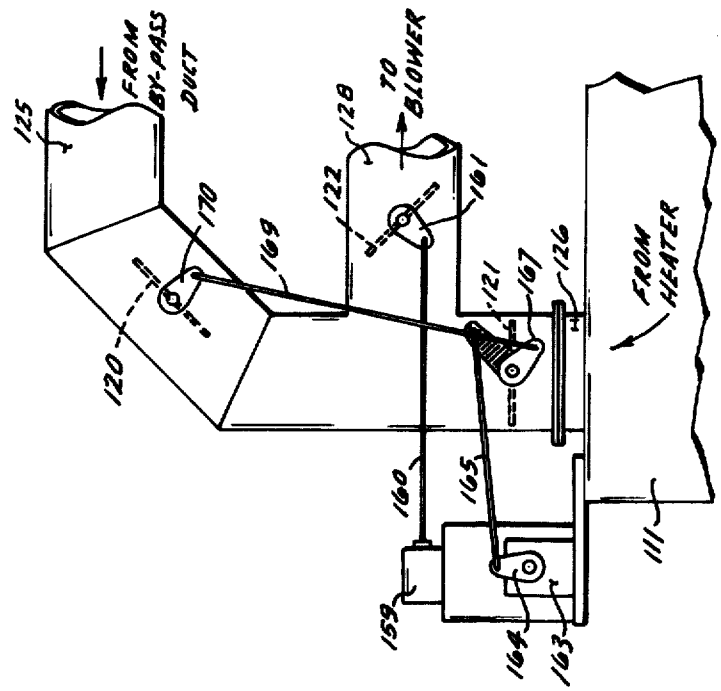

FROM BY-PASS DUCT
TO BLOWER
FROM HEATER
125
128
122
161
170
169
120
121
167
126
160
165
159
164
163
111

FIG. 5.

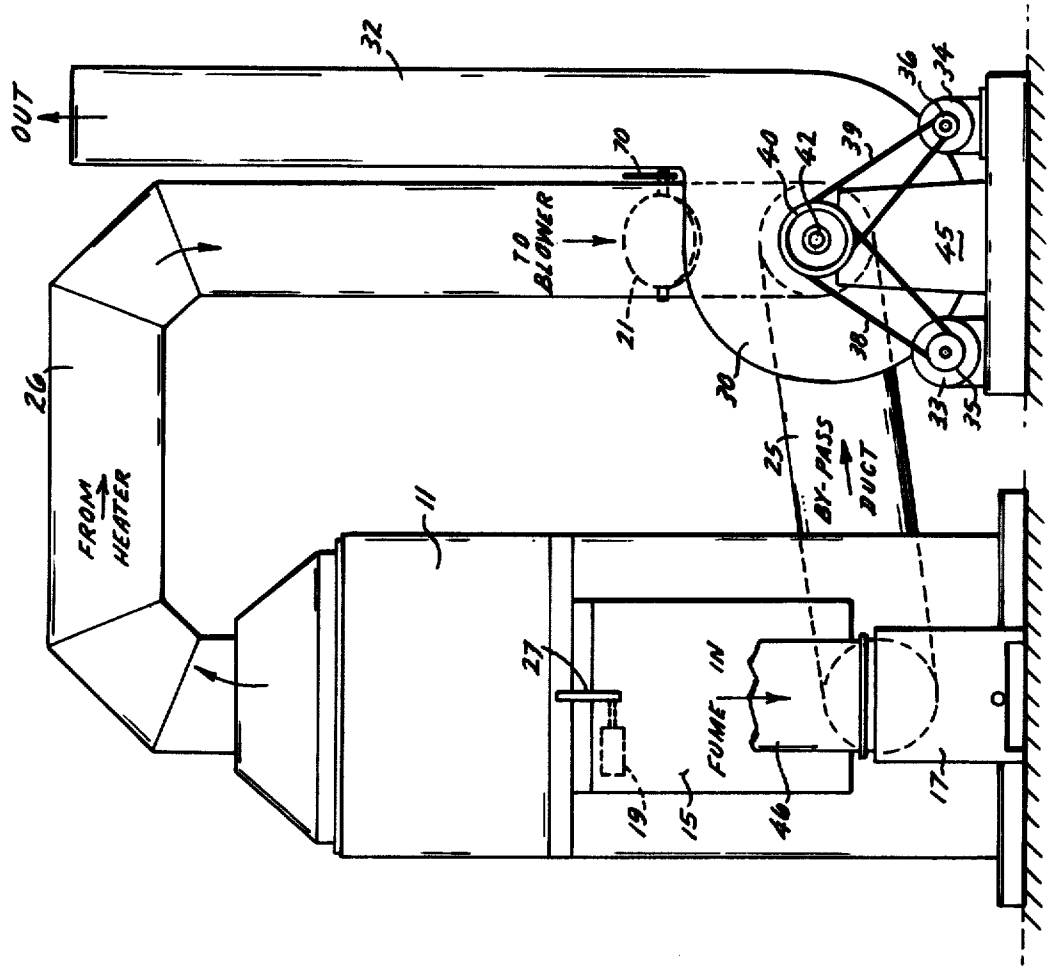
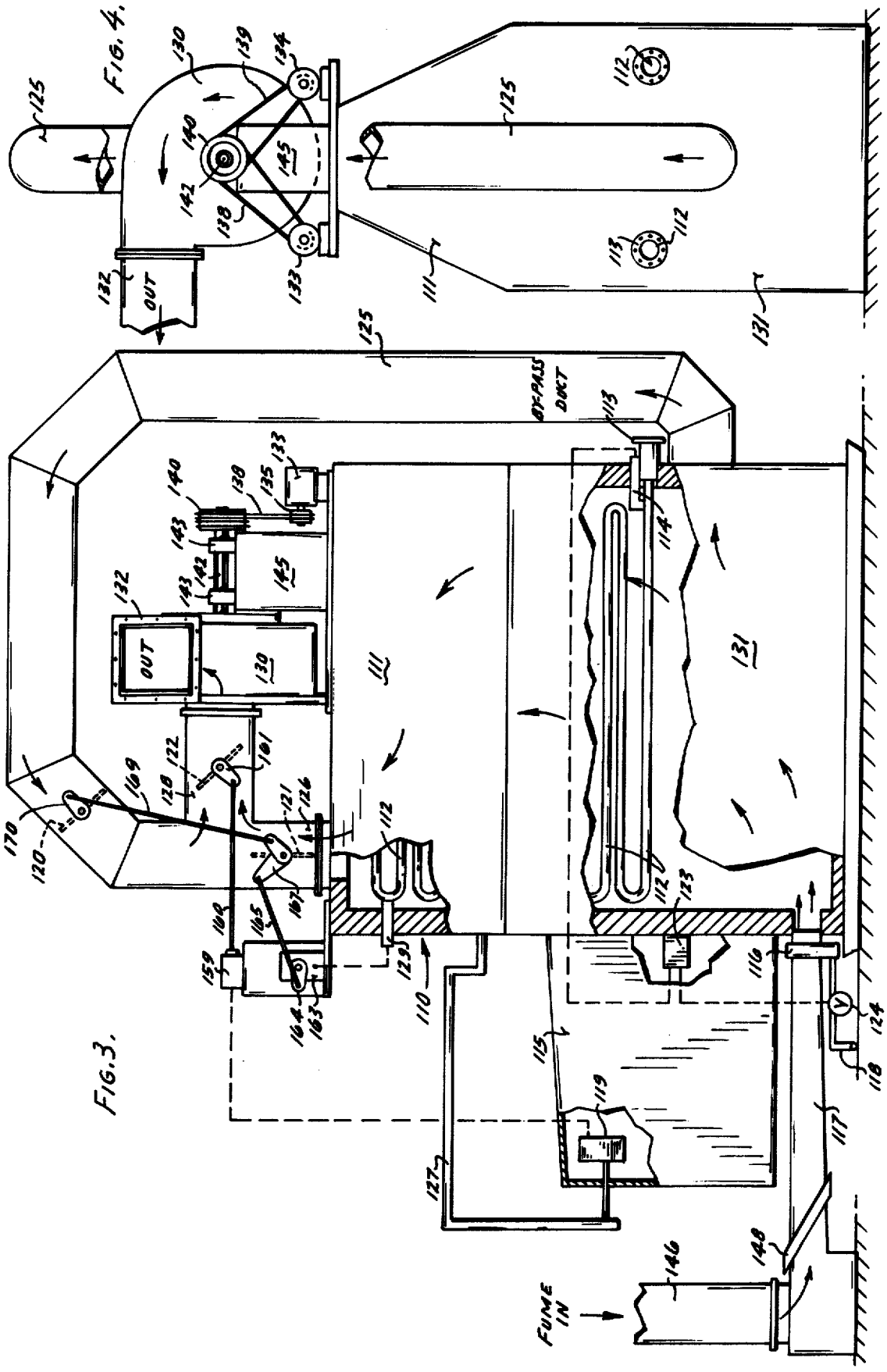

OUT
32
36
34
70
40
42
39
TO BLOWER
21
45
30
38
33
35
25
BY-PASS DUCT
26
FROM HEATER
11
27
FUME IN
19
15
46
17

FIG. 2.


FIG. 4.
FIG. 3.
OUT
BY-PASS DUCT
FUME IN

COMBINATION FUME OXIDIZER AND ASPHALT HEATER

BACKGROUND OF THE INVENTION

This invention relates to a burner and a method of substantially reducing fumes and odorous materials. More particularly, it relates to a method and apparatus for utilizing an odorous effluent stream from an asphalt shingle saturation apparatus in a manner to have it serve as a fuel source while at the same time regulating the heat of combustion of the combined fume and usual fuel gas stream by by-passing the heating chamber with a portion of the combined streams when temperature conditions indicate.

The manufacture of asphalt shingles inherently includes the application of hot vaporous asphalt material to an underlying base of felt material which results in fumes being exhausted to the surrounding atmosphere. This is an undesired situation in that such fumes can pollute the atmosphere and their heat value is lost.

It is an object of this invention to provide a method and apparatus for reducing air pollution wherein a normally odorous effluent stream of vaporized asphalt material is combusted while at the same time the heat effect of the stream is regulated. It is yet another object of this invention to afford a process and apparatus which will simultaneously reduce air pollution during asphalt shingle production and which is readily adapted to the usual production facilities of an asphalt shingle producer.

SUMMARY OF THE INVENTION

The foregoing objects are accomplished and the shortcomings of the prior art are overcome by the present process and apparatus wherein a fluid combustible material such as vaporized asphalt is directed toward a combustion zone containing burner elements for the asphalt heater. The combustible material is burned with an additional fuel stream and a portion of the combusted gases are directed toward the heating elements for additional asphalt. When temperature conditions indicate, another portion of the combusted gases is directed away from the heating elements and out through an exhaust duct or stack to the atmosphere where the first stream of gases which heated the asphalt is also directed. The apparatus for accomplishing the method of this invention includes a burner element through which the odorous asphalt stream is directed and a heating chamber which also contains a by-pass duct leading to an exhaust or outlet stack to which also is attached an intermediate duct from the heating chamber. Dampers are provided in the by-pass duct as well as in the intermediate or stack duct leading from the heating chamber for controlling the temperature within the heating chamber. An induction type fan is utilized downstream of the burner and the heating chamber to exert a pulling force on the by-pass stream as well as the stream heating the asphalt material to draw it through the burner and the heating chamber and to cause it to flow outwardly into the atmosphere through the exhaust duct. The method and apparatus of the invention is efficient enough so as to reach a temperature of 1600°F while affording an excess of one-half second retention time in the combustion chamber so as to burn all of the odorous asphalt material and thereby meet the most stringent air anti-pollution code requirements.

BRIEF DESCRIPTION OF THE DRAWINGS

A better understanding of the present process and the apparatus for accomplishing it will be afforded by reference to the drawing wherein:

FIG. **1** is a view in side elevation of the combined fume oxidizer and asphalt heater for effecting the process of this invention.

FIG. **2** is a front end view of the combined fume oxidizer taken along line **2—2** of FIG. **1**.

FIG. **3** is a view in side elevation of an alternative embodiment of a combined fume oxidizer and asphalt heater.

FIG. **4** is an end view in elevation showing the back of fume oxidizer and asphalt heater shown in FIG. **3**.

FIG. **5** is a partial view in elevation of the damper system shown in the FIG. **3** embodiment but with the damper in another position.

DESCRIPTION OF THE METHOD EMBODIMENT

The method of this invention comprises the steps of directing a fluid stream of odorous and smoke forming combustible material such as the effluent from an asphalt shingle saturation apparatus through a combustion zone. An additional fuel stream, such as natural gas or oil, is also directed to the combustion zone. The combined streams form a second zone of hot gases which are utilized to heat a material such as additional asphalt in a third zone. To control the heat of combustion of the two streams a portion of said combusted gases are directed away from the third zone and through a by-pass zone to an exhaust zone. The remaining portions of gases in the third heating zone are directed into the exhaust zone for recombination with combusted gases originally directed away from the third zone. In a preferred manner the streams of vaporized asphalt and fuel are drawn through various zones by a negative pressure and exhausted by a positive pressure. The stream of combusted gases which are diverted away from the third heating zone, and those which are not, are recombined in a common zone prior to being exhausted. The vaporized asphalt stream is directed through the combustion zone at an average rate of at least 20 feet per second with a retention time in the combustion zone of a minimum of one-half second, to effect a desired temperature of approximately 1400°F in the combustion zone and a temperature in the range of 490°–530°F for the heated asphalt.

DESCRIPTION OF THE FIRST APPARATUS EMBODIMENT

One apparatus for best carrying out the method of this invention is the combined fume oxidizer and asphalt heater generally **10** as shown in FIG. **1** which includes a heating chamber **11** having a multiplicity of coiled pipes **12**, an inlet **13** and an outlet (not shown) for flowing liquids such as asphalt into and out of the chamber for heating purposes. The heating chamber **11** with the coiled pipes **12** is of the standard type used in the asphalt shingle producing industry and is constructed of a refractory with an outer steel plate housing. Adjacent the heating chamber **11** is a burner canopy **15** which houses a burner element **16** in the form of a flame grid. Burner element or grid **16** is positioned in an intake duct **17** through which will be passed odorous and fume producing fluid combustible materials such as vaporized asphalt. Disposed upstream of the

grid 16 is a natural gas line 18 communicating with grid 16 for purposes of combusting the fumes and heating a fluid material such as asphalt in pipes 12. A thermocouple 14 through standard proportional motor control 23 positions a fuel valve 24 in line 18 to control the fire box temperature. A draft control system consisting of controller 19 and pressure sensor line 27 is located at the top of canopy 15 for sensing the pressure in chamber 11 and commands actuator 59 to position damper 22.

Dampers 20, 21 and 22 are pivotally positioned in the normal manner in three separate ducts or conduits as follows: damper 20 is located in by-pass duct 25 which is in communication with the back of chamber 11 and below coiled pipes 12; damper 21 is located in intermediate or stack duct 26 which is in communication with the top of heating chamber 11 and above the heating coils or pipes 12; damper 22 is operatively disposed in common duct or conduit 28. An induction type blower fan 30 is connected to common duct 28 at one end which is the negative pressure side and to an upright exhaust or blower duct 32 at the other end of blower 30 which is the positive pressure side.

Damper 22 is controlled by a standard actuator 59 by means of linkage 60 and 61. Dampers 20 and 21 are operated by a common air flow actuator 63 with a pivotal arm 64. A connecting link 65 interconnects with a double pivot arm clevis type connection 67 to which is attached another link 69 which in turn is secured to arm 70 on damper 21. Actuator 63 is commanded by thermocouple and controller 29 which senses the temperature of the leaving fluid in pipes 12.

As will best be seen in FIG. 2, blower 30 is driven by two motors 33 and 34 with motor 33 being of larger horsepower than motor 34 and having a larger sheave 35 than sheave 36. Suitable V-belts 38 and 39 drive the common sheave 40 independently on blower drive shaft 42 which is supported be bearing members 43 on support block 45.

Referring specifically to FIG. 1, an exhaust duct 46 from a standard asphalt saturator is in fluid tight communication with the upstream end of intake conduit 17. A condensate well and heavy particle trap 47 is provided opposite the connection with fume intake conduit 17. A steam snuff line connection 49, drain 50 and clean out door 52 are provided in and for trap 47. A flame retardant screen 48 is located across intake duct 17 just downstream of the communication with fume exhaust duct 46. To supply air for combustion when fumes are not being incinerated an air door 53 is disposed above intake duct 17 which is moved to a fully opened position by means of standard motor actuator 56 with the usual linkage 57 controls door 53. When fumes are being combusted air door 53 will be completely closed.

DESCRIPTION OF SECOND APPARATUS EMBODIMENT

Referring to the embodiment shown in FIGS. 3, 4 and 5 similar parts will be referred to by similar numbers as employed in describing the embodiment in FIGS. 1 and 2 except that they are in the "100" series. The basic difference between the combined fume oxidizer and asphalt heater 110 and 10 is that in embodiment 110 blower 130 is secured on top of heating chamber 111 rather than at the side as is blower 30 in relation to heating chamber 11. To accomplish this, by-pass duct 125 rather than the stack duct 26, is extended in a U-shaped manner up the back of chamber 111, across the top of chamber 111, over blower 130 and down along the front portion of chamber 111 where it joins common and intermediate or stack duct 126 in a T-junction. It will be noted that instead of a relatively high vertical exhaust duct as shown at 32 for fume oxidizer and asphalt heater 10 exhaust duct 132 is relatively short and extends a short distance from blower 130 in a horizontal direction. However, as will be explained later the general method of conducting combusted fuel and fumes through heating chamber 111 is the same. Consequently the damper arrangement in by-pass duct 125, stack duct 126 and common duct 128 except for the actuation of damper 120 in by-pass duct 125 and damper 121 in intermediate duct 126 is reversed in that double clevis arm 167 is located on damper 121 is in intermediate duct 126 rather than in by-pass duct 125. Although not illustrated in unit 110, an air door similar to 53 would be provided in intake duct 117 between flame retardant screen 148 and grid 116.

OPERATION OF FIRST EMBODIMENT

A better understanding of the advantages of the combined fume oxidizer and asphalt heater 10 as well as the method of this invention will be had by a description of the operation of unit 10. Natural gas from a suitable source and pressure is introduced into pipe 18 through valve 24 and into burner element 16 which is controlled by thermocouple 14. The usual ignition of the natural gas will be effected. At this point the blower fan 30 will be actuated by starting motor 33 which will effect a reduction of pressure in heating chamber 11 and a flow of gas and any air present in duct 17 in the direction of the arrows therein indicated. With a suitable flame being ignited across element 16 and with a flow pattern established as indicated by the arrows in duct 17, fumes from an asphalt saturation machine (not shown) will be introduced by suitable controls into exhaust duct 46 of the saturation machine. These fumes will flow through flame retardant screen 48 and along duct 17 across burner element 16 whereupon the combined streams of fumes and natural gas will become combusted in a first combustion zone immediately downstream of burner element 16. They will move away as indicated by the arrows from burner element 16 where the combusted substances will form a second zone of hot gases below the area of the coiled pipes 12 and indicated at 31. In the combustion of asphalt fumes to which this invention is particularly directed, it is desired to have a temperature of 1400°F in this area. When asphalt is to be heated to a temperature of approximately 510°F thermocouple 29 in the asphalt tubes and controller actuator 63 position dampers 20 and 21 accordingly. It should be understood that the temperature of the asphalt in pipes 12 is controlled independently of the fire box. When the asphalt temperature reaches 490°F the actuator 63 will be activated by thermocouple 29 and gradually open the by-pass damper 20 by moving pivot arm 64 downwardly and through double pivot arm 67 will cause the stack damper 21 in intermediate or stack duct 26 to close. These dampers will assume a 50% open or close position substantially as shown in FIG. 1 which will be in approximately the 50% full open or close position. This is effected by means of the interconnecting linkage

such as connecting link **65**, double clevis arm **67**, link **69** and arm **70** on damper **21**. This movement of dampers will divert a portion of some of the hot gases away from the third zone in the area of the coiled pipes **12** containing the asphalt to be heated and will divert it through the by-pass duct **25**. Should the temperature of the asphalt reach the limit temperature of 530°F the by-pass damper **20** would be fully opened and the damper **21** in the stack duct would be fully closed. As the temperature of the asphalt drops, the dampers would operate in a reverse manner through actuator **63**. At all times the fire box **31** would be maintained at its setting of 1400°F by its own thermal control system comprising thermocouple **14** proportional motor control **23** and valve **24**.

Damper **22** in common duct **28** serves to maintain a preset negative pressure in the fire box **31** utilizing the vacuum sensing line **27**, controller **19**, actuator **59** and linkages **60** and **61**.

The combusted gases from the natural gas and the fumes whether they are used to heat the asphalt in the coiled pipes **12** and thereby pass out the top of the heating chamber **11** and through stack **26** conduit or are by-passed by means of duct **25** will be combined in common duct **28** and exhausted to the atmosphere through exhaust duct **32** by first passing through blower fan **30**. At all times odorous and fume forming materials entering into fume duct **46** are combusted whether they are used for heating asphalt in the coiled pipes **12** in chamber **11** or not. Safety precautions are afforded in that a flame retardant screen **48** prevents any preignition of the vaporized asphalt should normal flow conditions not prevail. Heavy particles can be cleaned out of the system by means of clean outdoor **52**, and drain **50**.

In actual desired operating conditions, the heating chamber volume is approximately **330** cubic feet. The flow of fumes into fume or exhaust duct from the saturator **46** should be approximately 11,400 cubic feet per minute with a duct velocity on the average of 38 feet per second. The velocity of the fumes in the fire box **31** immediately downstream of the burner is approximately 20.2 feet per second with a retention time in this area of 0.503 second which exceeds most pollution code requirements.

OPERATION OF SECOND EMBODIMENT

The operation of the embodiment shown by the combined fume oxidizer and asphalt heater **110** is substantially the same as that described for unit **10**. The only difference is in the placement of the blower fan **130** on top of the heating chamber **11** thereby having a short stack or intermediate duct **126** rather than an elongated one **26** in unit **10** but by having an elongated by-pass duct **125**. It will be noted in this embodiment **110** that the damper **121** in the stack duct **126** will work opposite to that of damper **120** in by-pass duct **125** by means of double clevis **167** and link bar **169** as well as arm **170** on damper **120**. This described linkage will be operated by means of actuator **163** moving pivot arm **164** and connecting link **165**. The position of damper **121** in stack duct **126** and damper **120** in by-pass duct **125** in unit **110** as shown in FIG. **3** will indicate the maximum amount of combusted fumes and fuel gas which will pass through heating chamber **111** and across coiled pipes **112**. When a lower asphalt temperature is desired actuator **163** will be actuated which will cause double clevis arm **167** to move in a clockwise manner thereby closing damper **121** and opening damper **120** to divert a portion of the combined combusted fuel and fumes around coils **112** and out of the heating chamber through by-pass duct **125**. Both streams of combusted fuel and fumes whether passing through the heating chamber **111** or the by-pass duct **125** will be recombined in common duct **128** after which they will be passed through blower **130** and out through outlet duct **132** to the atmosphere. The operating conditions concerning flow of the fluid streams, retention times, et cetera, for unit **110** are approximately the same as that described for the previous unit **10**.

To achieve the flow velocities of the fluid fume stream through the various ducts, all of the duct work is fabricated from three foot internal diameter pipe having a **37** inch outside diameter. Preferably it is fabricated from stainless steel. This would include the exhaust ducts **46, 146** or inlet duct for the fumes, intake ducts **17, 117**, as well as by-pass ducts **25** and **125**, intermediate duct or stack ducts **26, 126**, common ducts **28, 128** and exhaust ducts **32** and **132**. A two motor system as described by motors **33, 34** and **133** and **134** which are of high and low speeds, respectively, provide an initial high flow rate through the heating chambers **11** and **111** and after the flow rate is achieved, the low speed motors can be utilized. This affords versatility and is achieved by a high speed motor of **50** horsepower rated at 1800 r.p.m. and a low speed motor of **20** horsepower and rated at 1200 r.p.m. The blower fans **30** and **130** are of a 37 inch size and rated at 31,374 cubic feet per minute at 807 r.p.m. The burner grids **16** and **116** are described in U.S. Pat. No. 3,524,632 and available from North American Manufacturing Co., in Cleveland, Ohio. These grids are rated at 19,695,900 BTU's and have a two inch water column pressure drop. Actuator **63** and **163** are of the proportional motorized operator type and available from Packer-Colman, Rockford, Ill. as well as the proportional motor control **23**. Controls **19, 119, 59, 159** are standard sequence draft controller and actuator set and available from Cleveland Controls, Inc., Cleveland, Ohio. Control **56** is of the reversing two position type available from Honeywell, Minneapolis, Minn.

Natural gas is indicated as the preferred fluid fuel in conjunction with burner grid **16**. However, other fluid fuels could be utilized in its place such as fuel oil, pulverized coal, propane and electricity, all with suitable burner, electrode or resistance elements.

It will be seen through the present invention that there is now afforded a combined fume oxidizing and heating system which can substantially reduce the air pollution problems normally associated with an asphalt production facility. At the same time, these fumes are utilized as fuel for heating additional asphalt material with the further advantage of controlling the temperature of the heating chamber by by-passing some of the combusted fumes around the heating chamber while at the same moment having these materials oxidized to a non-polluting state. Applicants' system for oxidation and heating is adaptable to any standard asphalt heater with a minimum of conversion to the heating unit. The minimum number of parts are employed in that only duct work and damper control means need be installed. Versatility is afforded in that the draft inducing fan can be located either along said heating unit or on top depending upon the customer's circumstances.

The foregoing invention can now be practiced by those skilled in the art. Such skilled persons will know that the invention is not necessarily restricted by the particular embodiments herein. The scope of the invention is to be defined by the terms of the following claims as given meaning by the preceding description.

We claim:

1. A combined fume oxidizer and asphalt heater comprising: means defining a heating chamber; fluid conduit means disposed in said heating chamber for flowing fluids into and out of said chamber for heating said fluids; a burner element for combusting fluid fuels in fluid communication with said chamber; means to supply fluid fuel to said burner element; an intake duct in communication with said burner element; an exhaust duct open at one end with the atmosphere and at the other end with said heating chamber; a by-pass duct in fluid communication with said chamber and said exhaust duct; means to supply with force combustible flowable fumes to said intake duct for combustion by said burner element and means to regulate the flow of said combusted fumes through said by-pass duct and said heating chamber.

2. The combined fume oxidizer and asphalt heater as defined in claim 1 further including an exhaust outlet duct in communication with an asphalt shingle saturating machine which conveys combustible fumes, said outlet duct secured in fluid communication with said intake duct.

3. The combined fume oxidizer and asphalt heater as defined in claim 1 wherein said means to regulate the flow of said combusted fumes is at least one damper disposed in said by-pass duct.

4. The combined fume oxidizer and asphalt heater as defined in claim 1 wherein said burner element is of the flame grid type.

5. The combined combustion fume oxidizer and asphalt heater as defined in claim 1 wherein said heating chamber includes U-shaped tubular members for conveying asphalt through the heating chamber.

6. The combined fume oxidizer and asphalt heater as defined in claim 1 wherein said means to supply with force said combustible flowable fumes is an induction type draft fan disposed between said heating chamber and said exhaust duct.

7. The combined fume oxidizer and asphalt heater as defined in claim 6 further including an intermediate conduit disposed between said heating chamber and said draft fan and including dampers in said intermediate conduit and said by-pass conduits and means to regulate said dampers including temperature sensing means operatively connected to said fluid conduit means.

8. The combined fume oxidizer and asphalt heater as defined in claim 7 further including a common conduit in communication with said by-pass conduit and said intermediate conduit and secured in fluid communication with said draft fan at the upstream side of said fan with said exhaust duct connected to the downstream side.

9. The combined fume oxidizer and asphalt heater as defined in claim 7 further including a damper in said common conduit, with said dampers in said intermediate and said by-pass conduits interconnected by means of mechanical linkage.

10. The combined fume oxidizer and asphalt heater as defined in claim 9 wherein the intake conduit is connected upstream of the burner element and upstream of the heating chamber.

11. A method of combusting odorous and fume forming combustible fumes present in a fluid state while utilizing and controlling the heat of combustion comprising: directing a fluid to be heated through a conduit in a heating chamber, directing said fluid combustible fumes toward a first combustion zone, burning a fluid fuel in said combustion zone to substantially combust said combustible fumes and form a second zone of hot gases; directing a portion of said gases in said second zone toward the heating chamber for heating said fluid and directing another portion of said gases in said second zone away from said heating chamber.

12. The method of combusting odorous and fume forming combustible fumes as defined in claim 11 further including the step of directing said gases from said heating chamber and the gases directed away from the heating chamber into a common exhaust zone.

13. The method of combusting odorous and fume forming combustible fumes as defined in claim 11 wherein said gases are directed into a common zone prior to the exhaust zone and an induction force is applied in said common zone to exert a pulling force on said combustible substances to draw them through said third zone as well as away from said third zone.

14. The method of combusting odorous and fume forming combustible fumes as defined in claim 11 including passing the fluid fuel and the odorous or smoke forming combustible fumes through a flame grid prior to the combustion zone.

15. The method of combusting odorous and fume forming combustible fumes as defined in claim 14 wherein the odorous or smoke forming combustible fumes are unburned asphalt fumes which are the result of the vaporization of asphalt.

16. The method of combusting odorous and fume forming combustible fumes as defined in claim 15 wherein said odorous or smoke forming combustible fumes are directed through said combustible zone at an average rate of at least about 20 feet per second.

17. The method of combusting odorous and fume forming combustible fumes as defined in claim 16 wherein said odorous or smoke forming combustible fumes are maintained in said combustion zone for a minimum of about one-half second.

18. The method of combusting odorous and fume forming combustible fumes as defined in claim 17 wherein said odorous or smoke forming combustible fumes and said fluid fuel are combusted to effect a temperature of at least about 1400°F.

* * * * *