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Childree et al.

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[54] **HOT BOX FOR ASPHALT**

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[21] Appl. No.: **176,108**

[52] **U.S. Cl.** ..... **126/343.5 A**

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

[58] **Field of Search** ..... 126/343.5 A, 343.5 R; 122/DIG. 11

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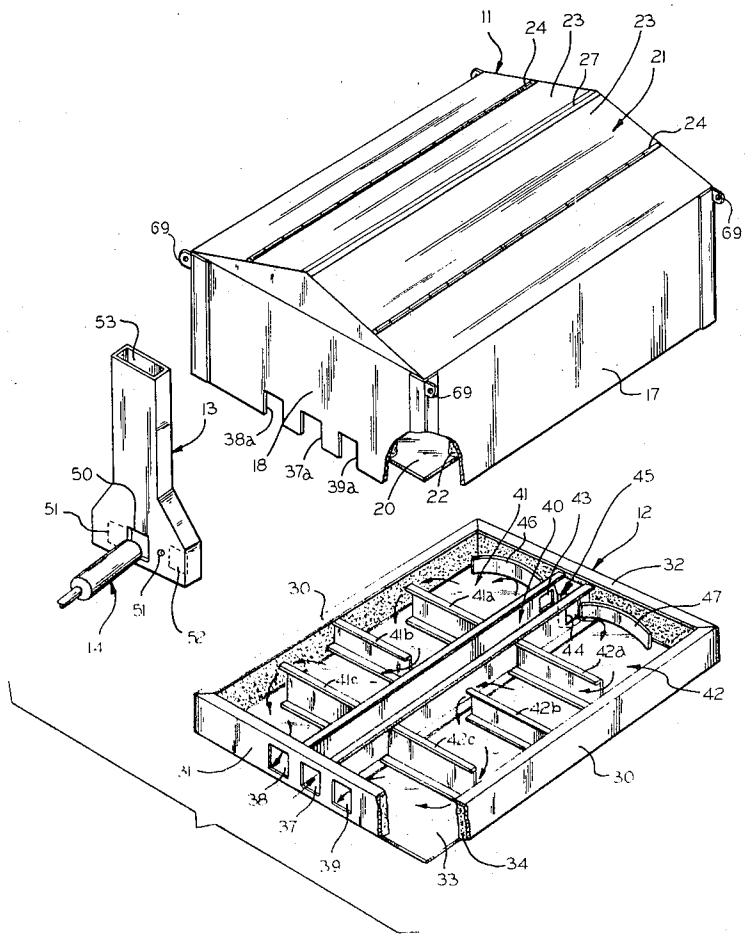
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[57] **ABSTRACT**

A hot box for maintaining asphalt at elevated temperatures including a closed and insulated container, a service apron, a heat exchanger for heating the container, a burner capable of producing high velocity hot gases for driving a mixture of hot gases and air through the heat exchanger and a temperature control system.

9 Claims, 5 Drawing Figures



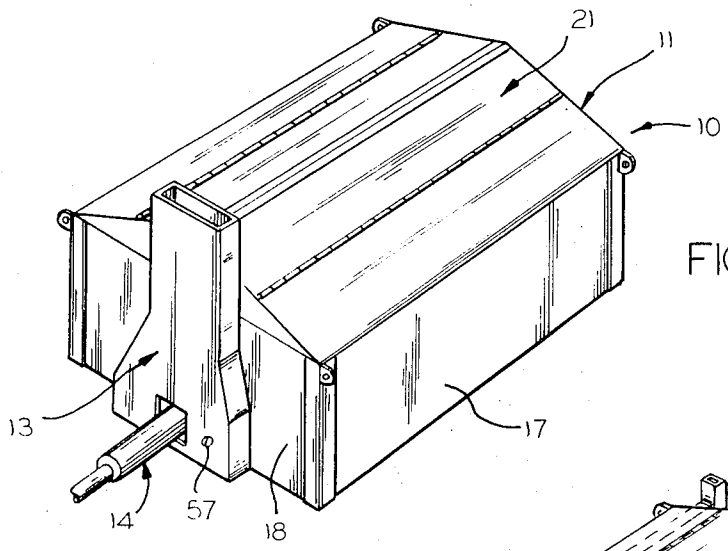


FIG. 1

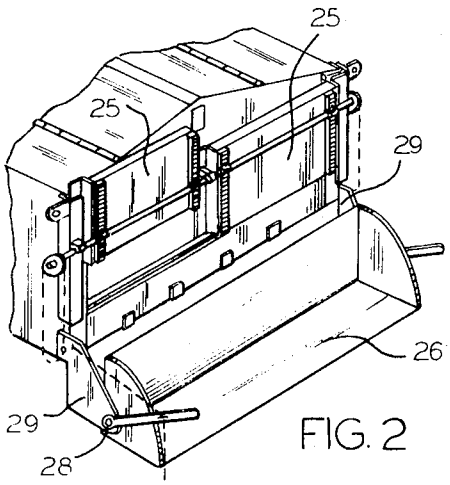


FIG. 2

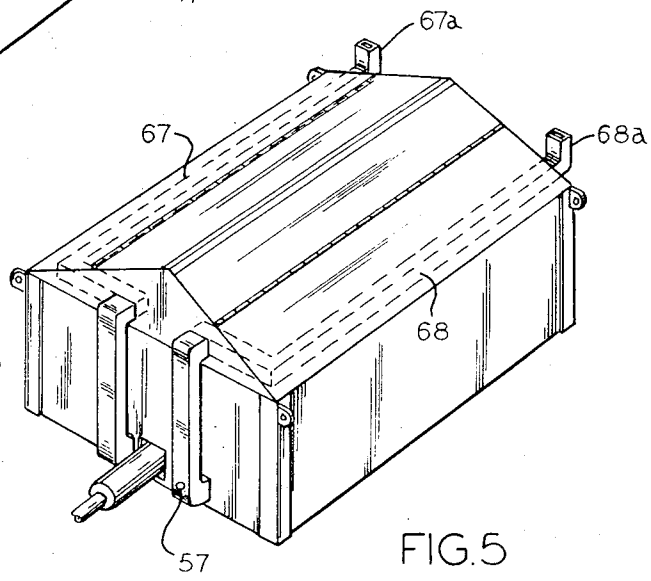


FIG. 5

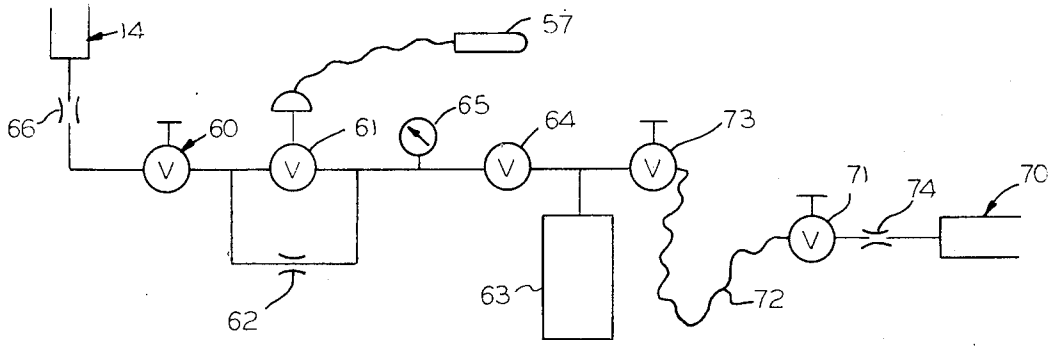


FIG. 4

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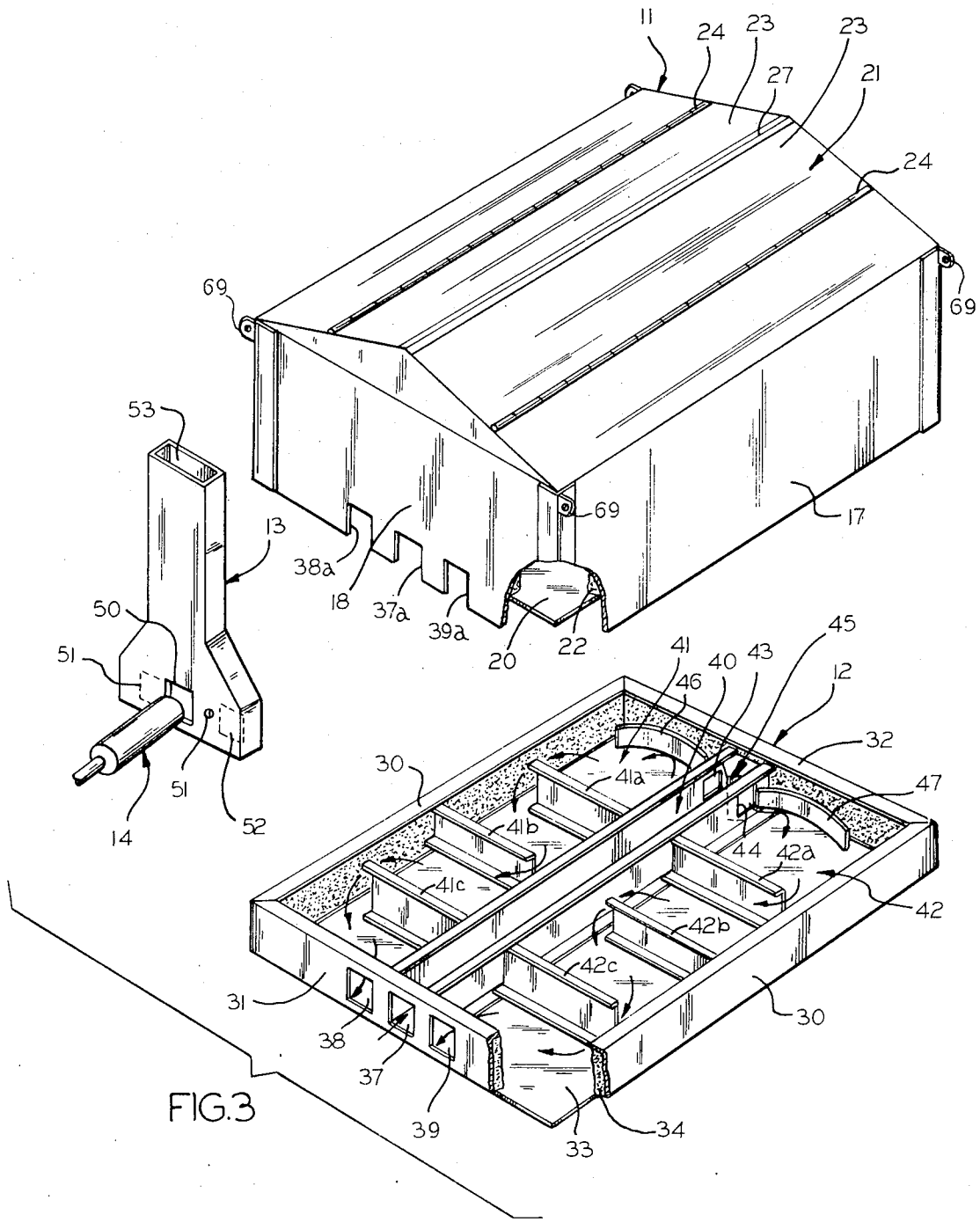


FIG.3

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HOT BOX FOR ASPHALT

The present invention relates to a hot box for maintaining road repairing asphalt at elevated temperatures to facilitate the making of proper road repairs in any weather and which is capable of being easily transported on a vehicle such as a truck or trailer.

Asphalt is used for repairing potholes, ruptured road surfaces and the like on asphalt or macadam roads. The term asphalt is used herein to mean a mixture of natural or petroleum asphalt and other materials such as rock, sand, gravel, shell or other aggregate in any proportion. The term "pothole" is used herein to refer to any road condition needing repair. Patching potholes in summer weather is not as difficult as doing so in the winter weather, but in any case it is necessary to maintain the asphalt used for repair at elevated temperatures when performing the patching work. Specifically, the asphalt must have a temperature sufficiently high for ease of workability and to enhance bonding of potholes. Usually, a temperature between 240° and 280°F is desired. Heretofore, it has been necessary to provide strategically located asphalt depots in order to transport quickly small quantities of asphalt to the locations needing repair. This has demanded a duplication of facilities, and has placed limitations on road repair crews to use the asphalt quickly after receiving it from a supply depot.

While there have been asphalt hot boxes heretofore developed such as the one disclosed in U. S. Pat. No. 3,386,435, none have been satisfactory from the standpoint of properly maintaining the asphalt in condition for facilitating road repair.

The present invention overcomes the difficulties heretofore encountered in providing a hot box for asphalt that maintains asphalt in proper condition for making road repairs for long periods of time, which will thereby eliminate the necessity of having several supply depots thereby enabling the use of only a single central supply depot for a road repair crew. The hot box includes a container within which the asphalt is held, and where the asphalt is maintained substantially free from the outside air to prevent oxidizing and crusting of the top surface. A heat exchanger is mounted below the container to uniformly distribute heat along the entire bottom wall of the container and transfer same through the bottom wall to the material in the hot box. The heat exchanger includes compartments through which a mixture of hot gases and air is driven after which the hot gases and air may be exhausted to the atmosphere or ducted back into the asphalt holding cavity for additional heat transfer to the top surface of the asphalt. A burner is provided for producing the hot gases, and which is capable of producing hot gases having a high velocity, thereby aiding in the induction of air mixing with the gases to enter the heat exchanger compartments and to provide the necessary force for driving the mixture of hot gases and air through the exchanger. The container is closed and substantially air-tight to prevent oxidation of the top surface of the asphalt. A service apron is provided for holding the hot asphalt after removal from the hot box but before it is placed in a pothole. The entire hot box is capable of being easily moved onto a vehicle or from a vehicle onto a ground support to allow freeing of the vehicle for other uses. Additionally, it is conceived to utilize the exhaust gases from the heat exchanger and drive them through duct work running through the inside of the container at the top to further transmit heat into the container.

While the hot box is capable of maintaining the asphalt at proper temperature for making road repairs, there is a problem in repairing roads that is especially evident when repairing potholes. The mere application of hot asphalt to a pothole does not always result in a suitable repair as a vapor or contaminant joint may develop between the pothole and the asphalt by virtue of moisture in the pothole and other contaminants such as dirt and sand. The invention, therefore, further contemplates means for preparing the pothole to receive the asphalt and provide the proper bond. In this respect, a hand held burner having a very high velocity gas flame serves to blow sand, dirt and other contaminants out of a pothole, drive out any moisture, heat, and thus soften the edges and surface of the pothole and bring the surface of the pothole to the temperature of the asphalt being placed therein so that a proper bond is achieved between the pothole and the repair asphalt to enhance the lifetime of the repair.

It is, therefore, an object of the present invention to provide a new and improved hot box for asphalt.

Another object of the present invention is in the provision of a hot box for asphalt which includes a substantially air-tight container for the asphalt, a heat exchanger for transmitting heat to the asphalt through the container, and a high velocity gas burner for supplying heat to the heat exchanger, together with a mixture of burner induced air.

A further object of this invention is in the provision of a hot box having a heat exchanger that uniformly heats the asphalt throughout the hot box.

A still further object of this invention is in the provision of a hand held burner capable of preparing a pothole for accepting the repair asphalt and eliminating the contaminant joints which prevent proper bonding between the repair asphalt and the pothole.

Other objects, features and advantages of the invention will be apparent from the following detailed disclosure, taken in conjunction with the accompanying sheets of drawings, wherein like reference numerals refer to like parts, in which:

FIG. 1 is a perspective view of the hot box according to the invention, and showing one end thereof;

FIG. 2 is a fragmentary perspective view of the opposite end of the hot box in FIG. 1;

FIG. 3 is an exploded perspective view of the hot box showing the container separated from the heat exchanger and the chimney and burner arrangement separated from the container;

FIG. 4 is a schematic view of the burner employed with the hot box, the temperature control system and the manually operated burner for preparing the road; and

FIG. 5 is a perspective view of a modification.

Referring now to the drawings, and particularly to FIGS. 1 to 3, the hot box according to one embodiment of the invention, generally indicated by the numeral **10**, includes a container **11** for holding asphalt, a heat exchanger **12**, a stack **13**, and a burner **14**.

The container **11** includes opposite upstanding side walls **17,17**, front and back walls **18** and **19**, a bed plate or bottom wall **20** and a roof or top wall **21**. The side

walls, front and back walls and roof are provided with a suitable insulation **22**. The side, front and back walls extend below the bottom wall **20** to telescope over the heat exchanger **12** which fits directly up against the bottom wall **20**. The bottom wall does not carry any insulation as it is through this wall that heat is transmitted from the heat exchanger. The roof **21** includes a pair of doors **23,23** hinged at **24,24** which may be suitably opened when loading the holding chamber of the container with asphalt. Two service doors **25** are provided in the end wall **19** to permit unloading of asphalt from the container. A service apron **26** is provided which holds the hot asphalt after removal from the hot box through the service doors **25** and before the asphalt is used to fill or repair a pothole. The service apron is supported by hinges **28** carried on mounting plates **29** extending from the container **11** and can be adjusted to various heights to facilitate removal of the asphalt such as by manually using shovels. The service apron can also be tilted to allow the dropping of asphalt to the road surface at adjustable rates. The doors **23** through which asphalt is loaded are formed to close and provide a weatherproof joint **27** at their central engaging edges. Further the hinges **24** are weatherproof. In order to prevent oxidation of the top surface of the asphalt and crusting, the doors **23** are also essentially airtight to prevent the entrance of air into the container.

The heat exchanger **12** includes opposed side walls **30,30**, front and back walls **31** and **32**, and a bottom wall **33**. The side walls are insulated in a similar fashion to the insulation in the side walls in the container by providing suitable insulation **34** such as a mineral wool.

The front wall **31** of the heat exchanger is provided with a centrally located inlet port **37** and on each side thereof outlet ports **38** and **39**. These ports respectively align with cut-outs **37***a*, **38***a*, and **39***a* formed in the lower part of the container side wall **18**.

The inlet port **37** leads to a firing tube **40** which is arranged centrally through the heat exchanger, thereby splitting the heat exchanger into heat exchange compartments **41** and **42**. The firing tube **40** is rectangular in cross-section and provided with a pair of outlets **43** and **44** at the end remote from the inlet port **37**, which outlets intercommunicate the firing tube with the heat exchange compartments **41** and **42**. A V-shaped deflector plate **45** is provided adjacent the outlets **43** and **44** to split the flow of gases through the outlets into the compartments. Turning vanes **46** and **47** are provided adjacent the outlets **43** and **44**. It will be noted that the firing tube **40** is not attached to the back wall **32** so as to provide thermal expansion and to protect the back wall from impingement by the high velocity hot gases. Additionally, the firing tube, together with the side, front and back walls of the heat exchanger, define load bearing points for the floor or bottom wall **20** of the container.

Suitable baffles **41***a*, **41***b*, and **41***c*; **42***a*, **42***b* and **42***c*, are respectively provided in the heat exchange compartments **41** and **42** to define a circuitous route for the flow of gases through the compartments to enhance the heat transfer through the floor of the container. The baffles are alternately open at opposite ends to force the flow of gases back and forth across the compartment and bottom surface of the bedplate **20** as they move from the outlets of the firing tube to the outlet ports **38** and **39**. Additionally, the baffles provide load bearing points for the floor of the container. Further, the baffle configuration enables thermal expansion of the heat exchanger without significant warpage. Thus, the heated air and gases will enter the inlet port **37**, pass through the firing tube **40**, be discharged through outlets **43** and **44** into one end of the heat exchange compartments **41** and **42**, flow circuitously around the baffles and heat exchanger and exhaust through the outlet ports **38** and **39**.

The stack assembly **13** is provided with a central passageway **50** aligning with the inlet port **37** for the purpose of transmitting a mixture of hot gases and induced air into the firing tube. Inlet openings **51** and **52** align with the outlet ports **38** and **39** of the heat exchange chambers to intercommunicate the stack with the outlets of the chambers. A top discharge opening **53** is provided in the stack through which are exhausted the spent mixture of gases and air.

The burner **14** is of a type that is capable of producing high velocity hot gases wherein the hot gases are discharged into the passageway **50**, and at the same time induce the flow of air therein to mix with the hot gases which will be driven through the firing tube and heat exchange compartments. The operation of the burner **14** is automatically controlled by a temperature sensing unit arranged within the stack to sense the temperature of the exhaust gases so that the asphalt in the container is maintained between 240° and 280°F. Thus, the sensing element generally indicated by the numeral **57** is arranged at one of the outlet ports of the heat exchange compartments, such as illustrated in FIG. **3**, where it is arranged adjacent the outlet port **39**.

The burner **14** is connected to a shutoff valve **60**, FIG. **4**, which is in turn connected to a fuel control valve **61** and a by-pass orifice **62** which receives fuel under regulated pressure from a tank **63**. The fuel control valve **61** is modulated by the temperature detected by the sensor tube **57**. Fuel pressure to the fuel control valve **61** is set and controlled by a regulator **64** which may be read out at gauge **65**. The by-pass orifice **62** is sized to provide a low fire input to the burner **14** when the fuel control valve **61** is fully closed.

In operation, the burner **14** is manually lit by placing an ignition flame at its nozzle end and slowly opening shut-off valve **60** which allows fuel to flow through the control valve **61** and orifice **62**. The gas flows through a nozzle **66** where it mixes with air and enters the combustion chamber of the burner. The reaction of the air-gas mixture produces the required hot gas at the burner **14** which is then directed into the firing tube of the heat exchanger. As the hot gases are discharged from the burner at the passageway **50** the kinetic energy of the high velocity hot gases induces air into the firing tube. The flame temperature of the hot gases at the burner is between 2,800° and 3,000°F while the hot gas velocity is between 200 and 300 feet per second and the approximate heat input is 100,000 BTU per hour. It is this high velocity that produces the induction of air with the hot gases into the firing tube. The temperature of the exhaust gases, as detected by the sensor tube **57**, thereafter controls the operation of the burner to maintain the temperature of the asphalt at a selected temperature.

In order to further utilize the exhaust gases and extract heat therefrom, a modification is illustrated in FIG. 5 wherein the exhaust gases are discharged through ducts 67 and 68 arranged in the upper part of the container above the top level of the asphalt to additionally give off heat in the container. These ducts then are provided with short stacks 67*a* and 68*a* for exhausting the gases to the atmosphere after they have passed through the ducts in the container. Otherwise, this embodiment is identical to that of FIGS. 1 to 3. It should be appreciated that exhaust gases may discharge into a single duct extending through the top of the container or any number of ducts.

While the size of the hot box may vary, a typical size would include a unit that is 96 inches long, 76 inches wide and about 49 inches high. The height of the heat exchanger would be about 50 inches. It should be appreciated that such a unit could be easily transported on any vehicle such as a truck or trailer to a desired location and there unloaded so that the truck or trailer could be otherwise used during the unloading of asphalt from the hot box for repair work. Lifting lugs 69 at the corners facilitate unloading. It will, therefore be appreciated that the hot box is capable of providing asphalt at elevated temperatures, wherein an automatic temperature control system maintains the temperature of the asphalt in a workable range for long periods of time.

In order to obtain a satisfactory repair, it is necessary to prepare the area to be repaired properly before applying asphalt. The invention further contemplates a method of preparing an area to be repaired, such as a pothole, by blowing out any sand or contaminants, driving out any moisture and heating the edges of the pothole to the temperature of the asphalt repair material as it comes from the hot box. Therefore, a satisfactory bond can be obtained between the repair material and the pothole.

As seen in FIG. 4, it is contemplated that a portable manually operated burner 70 can be used to properly prepare a pothole for patching purposes. The burner 70 includes a hand control valve 71 that is connected through a flexible line 72 to a valve 73 and the fuel tank 63. The high pressure gas for the burner 70 is therefore obtained from the tank 63. A nozzle 74 is provided ahead of the burner 70 to effect mixing of the gas with air prior to it being discharged into the combustion chamber of the burner. The burner may be manually ignited by a suitable flame as the control valve 71 is slowly opened. The burner is designed to produce a high temperature, high velocity, hot gas flow of a temperature of 2,800° to 3,000°F with a velocity of 300 to 400 feet per second and a heat input of 300,000 BTU per hour. Accordingly, the burner is capable of quickly and efficiently cleaning a pothole, driving out the moisture and conditioning the pothole to receive the asphalt repair material and provide a good bond between the repair material and the pothole.

It will be understood that modifications and variations may be effected without departing from the scope of the novel concepts of the present invention, but it is understood that this application is to be limited only by the scope of the appended claims.

This invention is hereby claimed as follows:

1. A hot box for maintaining asphalt at elevated temperatures comprising, a container having top, bottom and side walls defining a holding chamber for asphalt, burner means generating high velocity hot gases, and a heat exchanger between the burner means and the container, said heat exchanger including side walls contiguous with and extending down from the side walls of said container and a bottom wall coacting with the side walls and the bottom wall of the container to define a chamber, a firing tube extending centrally into the heat exchange chamber separating same into two heat exchange compartments, said firing tube having an inlet port and a pair of outlet ports, one outlet port for each compartment, said burner means being arranged at the inlet port to discharge its hot gases therein and to induce air into the firing tube and drive a mixture of air and gases through the heat exchanger, baffle means in each compartment defining a continuously reversing gas flow path, and discharge ports in the compartment side walls to discharge the gases therefrom.

2. The combination of claim 1, wherein deflector means is provided in the firing tube to split the mixture of air and gases into the compartments.

3. The combination of claim 1, wherein the container is formed to be essentially airtight and weatherproof.

4. The combination of claim 1, and a stack connected to the outlet ports to exhaust the mixture of air and combustion gases above the container.

5. The combination of claim 1, wherein the side walls of the container and heat exchanger are insulated, and the heat exchanger extends under the entire bottom wall of the container.

6. The combination of claim 1, wherein an adjustable service apron is provided to hold the hot asphalt during an interim period of time after removal from the hot box but before application to a pothole, said service apron being hinged and thus capable of being tilted to allow asphalt to be dropped from it to the road service at adjustable rates.

7. The combination of claim 6, and temperature sensing means in the stack for controlling the operation of the burner.

8. The combination of Claim 6, wherein the burner produces hot gases having a temperature of about 2,800°F and a velocity of 200 to 300 feet per second.

9. An asphalt hot box comprising a container for asphalt defined by top, bottom and side walls, a heat exchanger directly below the container for transferring heat to the asphalt in the container, said heat exchanger including side walls aligned with the side walls of the container, a bottom wall and being open at the top in direct communication to the bottom wall of the container, whereby gases flowing through the heat exchanger scrub the bottom wall of the container, a fire tube extending centrally through the heat exchanger having an inlet port at one end and a pair of outlet ports at the other end and separating the exchanger into two heat exchange compartments, the outlet ports intercommunicating the heat exchange compartments and the fire tube, baffle means in the heat exchange compartments for causing a circuitous flow path for hot gases, exhaust ports for the heat exchange compartments leading to a stack, and means generating and driving a mixture of air and hot gases into said inlet port and through said heat exchanger.

* * * * *