Jan. 2, 1968 H. E. LUND 3,361,358

APPARATUS FOR SPREADING BITUMINOUS MATERIAL

Filed Jan. 28, 1966 4 Sheets-Sheet 1

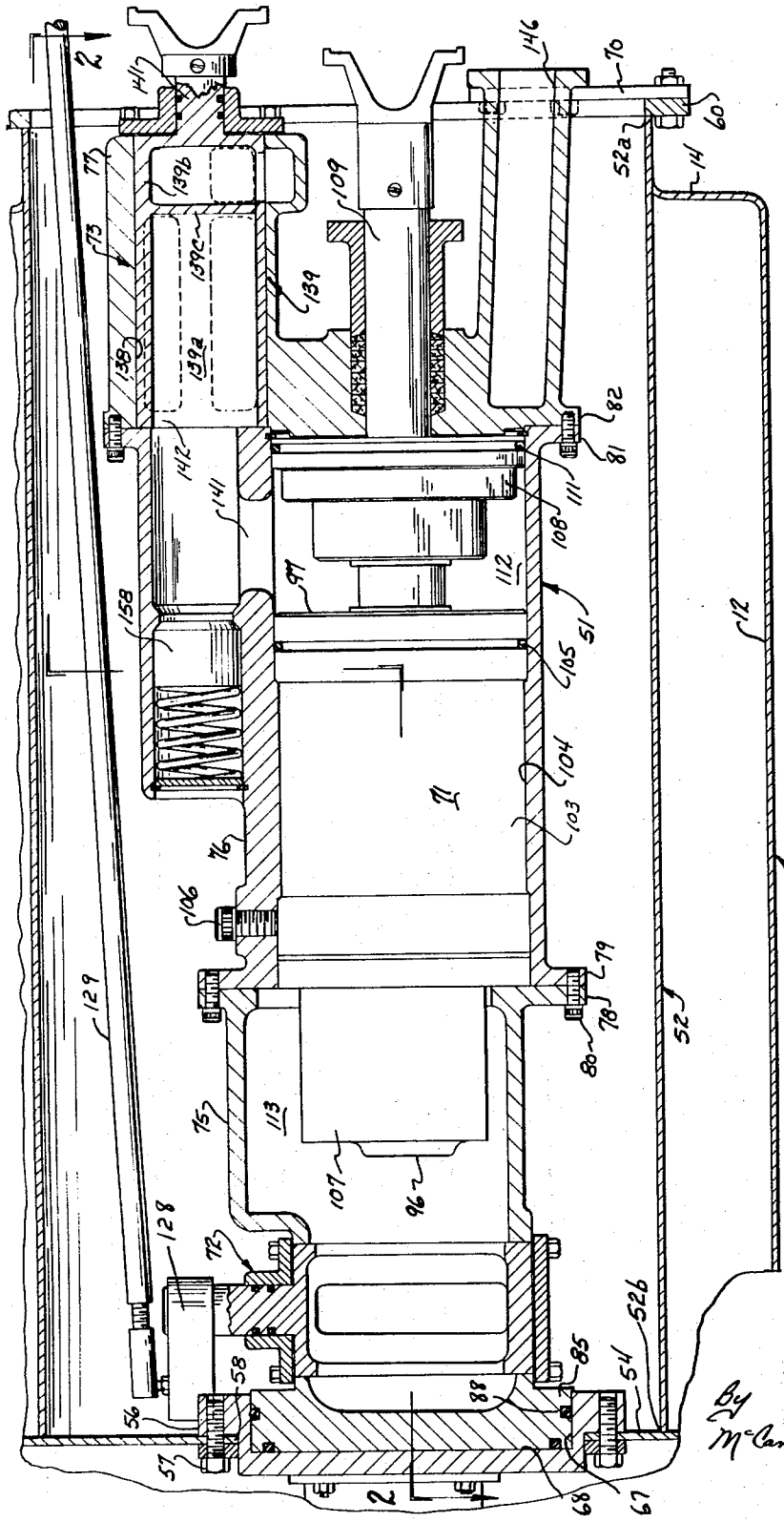


Fig. 1.

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APPARATUS FOR SPREADING BITUMINOUS MATERIAL

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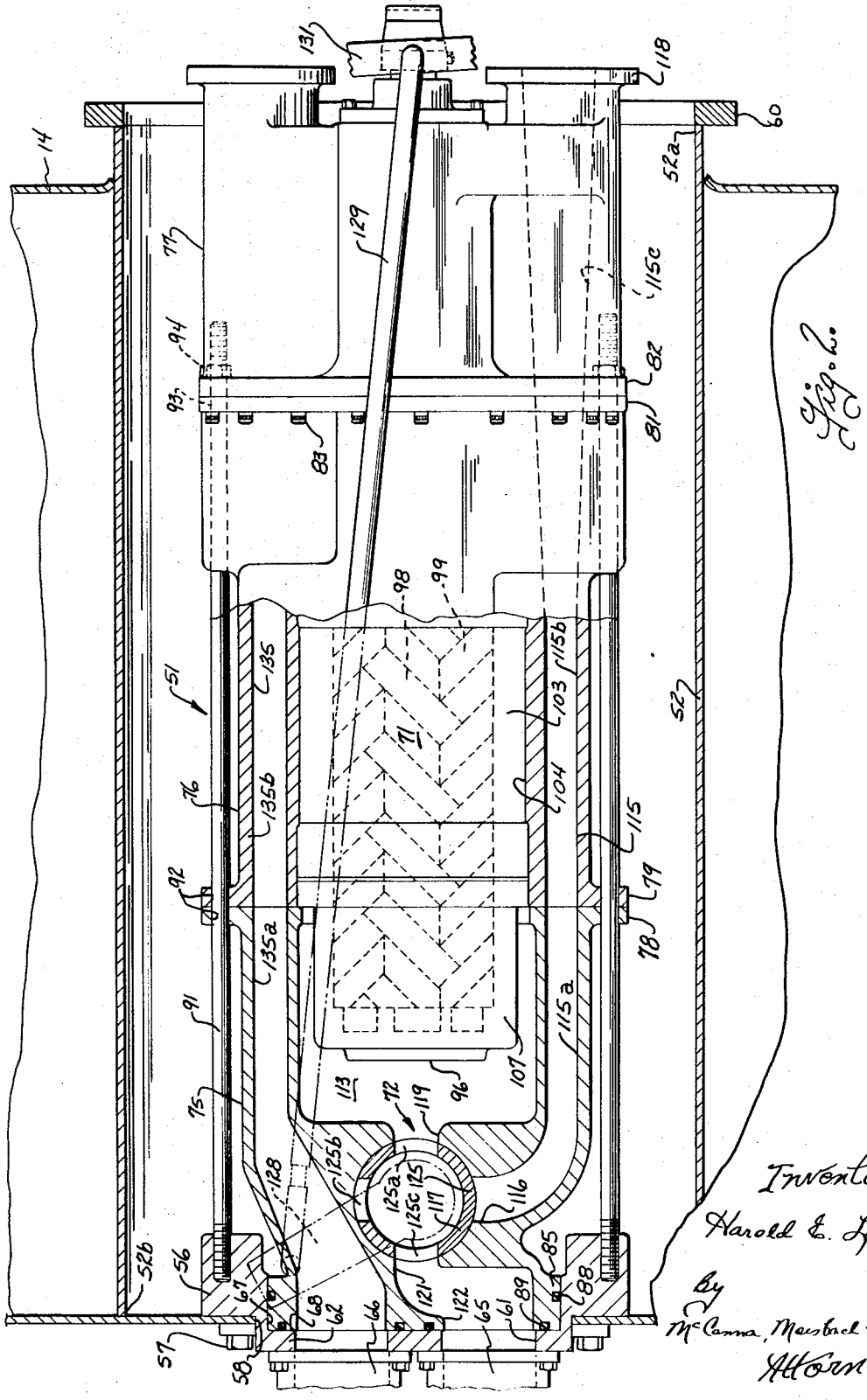


Fig. 2.

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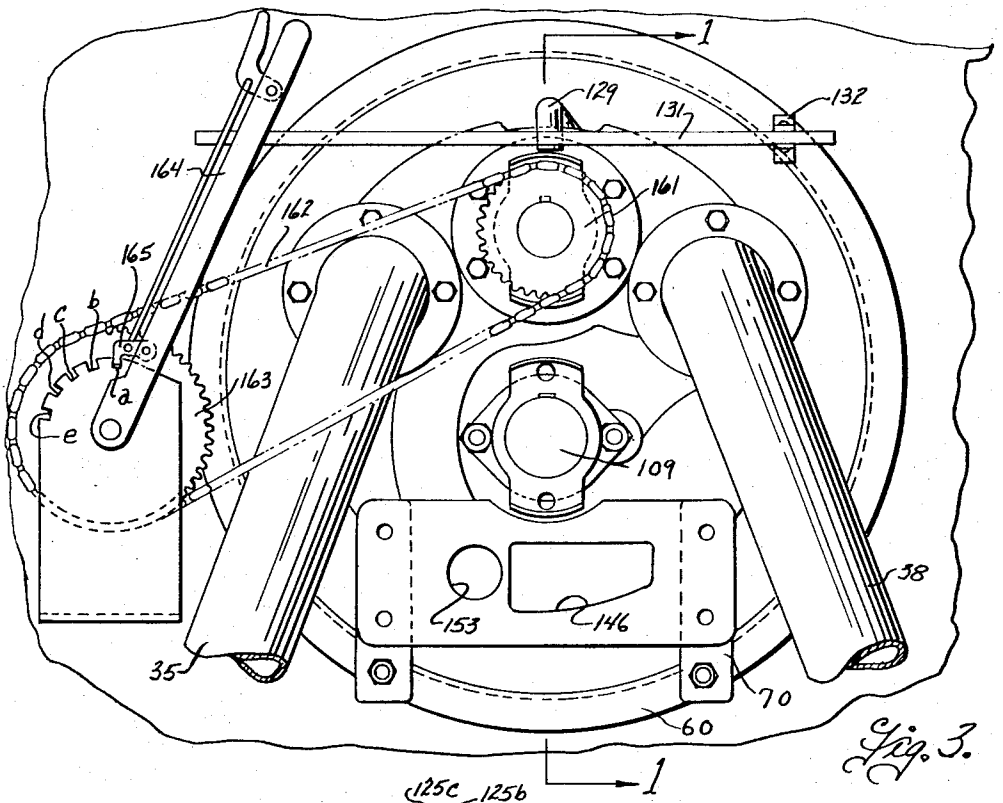


Fig. 3.

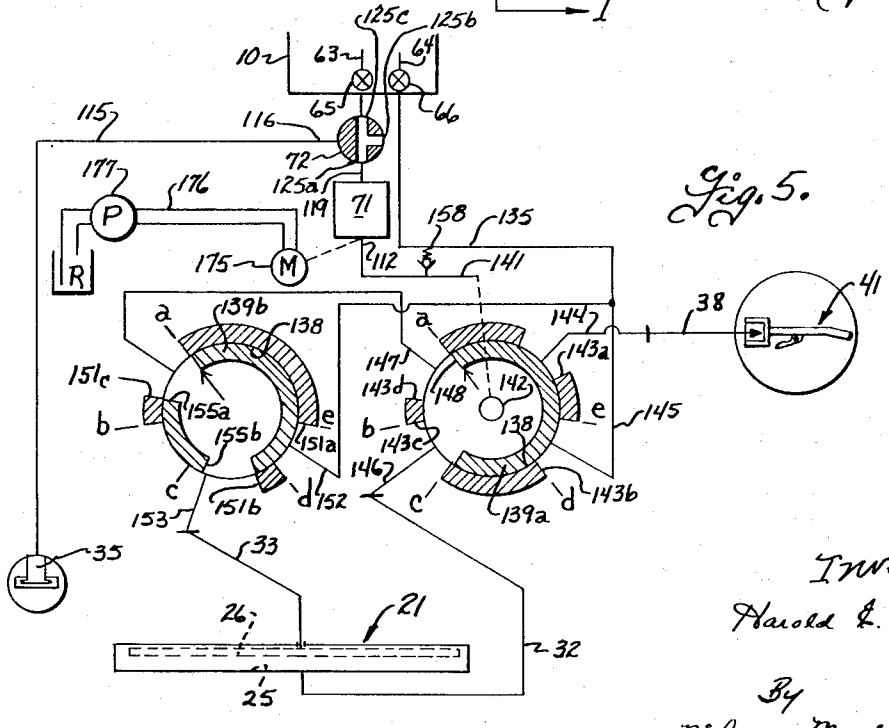


Fig. 5.

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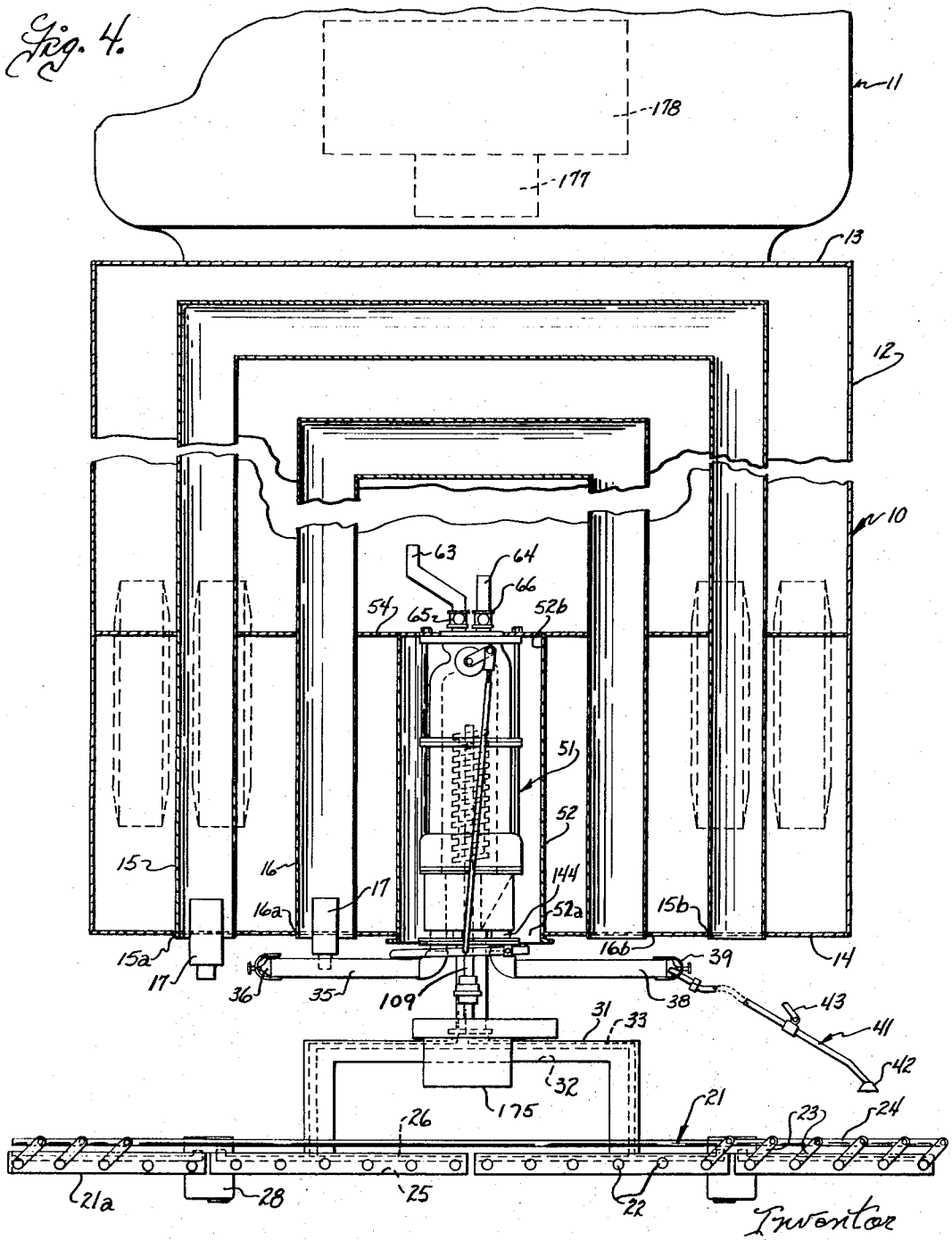
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APPARATUS FOR SPREADING BITUMINOUS MATERIAL

Filed Jan. 28, 1966 4 Sheets-Sheet 4

Fig. 4.



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APPARATUS FOR SPREADING BITUMINOUS MATERIAL

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Filed Jan. 28, 1966, Ser. No. 523,691

17 Claims. (Cl. 239—130)

This invention relates to apparatus for spreading bituminous materials and the like.

Bituminous materials become more viscid and tend to congeal when cool, and it is the common practice to heat the bituminous materials in the storage tank to facilitate spreading and application of the bituminous material in a liquid state on the surface to be covered. However, problems are still encountered in conventional tank type spreader apparatus due to congealed bituminous material in the pump and valves for controlling the flow of the material to the material distributor. Congealed bitumen in the pump and valves makes it difficult to start and operate the same. Once the pump and valves are started and operated, the circulation of heated bitumen through the pump and valves tends to heat them. However, at low flow rates, or when the bituminous material is only intermittently dispensed as in patchwork, and particularly in cold weather, the flow of heated bitumen through the pump and valves may not be adequate to maintain the temperature of the pump and valves sufficiently high for proper operation.

It is accordingly an important object of this invention to provide an apparatus for spreading bituminous materials having an improved arrangement for heating the pump prior to operation of the same and for maintaining the pump in a heated condition during operation.

Another object of this invention is to provide an apparatus for spreading bituminous material in accordance with the foregoing object, which also heats the valves for controlling the flows of material between the pump and tank and between the pump and distributor.

Another object of this invention is to provide an apparatus for spreading bituminous material having an improved arrangement for heating the pump and flow control valves and which avoids heating of the pump and valves to excessively high temperatures and also voids nonuniform heating of localized areas of the pump and valves.

A more particular object of this invention is to provide an apparatus for spreading bituminous material of the type having means for heating the bituminous material in the storage tank, in which the pump and valves for controlling the flow of material to and from the pump are mounted within the bitumen storage tank to be heated as the material in the tank is heated.

A further object of this invention is to provide an apparatus for spreading bituminous material having an improved arrangement for mounting the pump in the tank to facilitate removal and replacement of the pump without requiring draining of the tank.

Yet another object of this invention is to provide an apparatus for spreading bituminous material wherein the pump and valves for controlling the flows of fluid to and from the pump are mounted within the tank to be heated by the material in the tank and in which the pump and valves can be installed and removed as a unit from the tank.

Still another object of this invention is to provide an apparatus for spreading bituminous material having a simplified pump and valve arrangement which enables pumping of material from a supply source into the tank; recirculation of material from the tank to the pump and back into the tank for more uniform heating of the material in the tank; recirculation of the material from the tank through the material distributor and back into the tank to heat the distributor; delivery of material from the tank to the distributor; delivery of material from the tank to either a discharge outlet or an auxiliary spray apparatus; and transfer material from the supply source to a delivery outlet without passing through the tank.

These, together with other objects and advantages of this invention will be more readily understood by reference to the following detailed description when taken in connection with the accompanying drawings wherein:

FIGURE 1 is a vertical sectional view taken on the plane 1—1 of FIG. 3, and illustrating the pump and valve assembly mounted in an oven type enclosure in the material storage tank;

FIG. 2 is a fragmentary view taken on the broken section line 2—2 of FIG. 1, and illustrating the pump and valve assembly partially in section and partially in elevation;

FIG. 3 is a fragmentary rear elevational view of the pump and valve assembly mounted in a tank;

FIG. 4 is a diagrammatic view illustrating the pump and valve assembly mounted in the tank of a truck type spreader apparatus; and

FIG. 5 is a schematic diagram illustrating the pump and valve arrangement for controlling the several flows of material through the apparatus.

The present invention is generally adapted for use in apparatus for spreading bituminous and asphaltic materials and the like, hereinafter referred to as bituminous materials, and is diagrammatically shown in FIG. 4 applied to a truck type apparatus for spreading bituminous materials over a surface traversed by the truck. In general, the truck type spreader apparatus includes a material storage tank 10 mounted either directly on a truck 11 as shown, or on a trailer chassis to be drawn by a truck. While the tank can have any suitable configuration, the tanks commonly have side walls 12 generally in the form of a circular or oblate cylinder, and forward and rear end walls 13 and 14. While the end walls are herein shown flat, it is understood that in accordance with good tank construction practice, it is preferable to form the end walls with a dished configuration. The tank has the usual access opening (not shown) adjacent the top and a means is provided in the tank for heating the bituminous material. As shown, this means includes flue tubes designated 15 and 16, conveniently of generally U-shaped configuration and having inlets 15*a*, 16*a* and outlets 15*b*, 16*b* opening at an outer wall of the tank, such as the rear wall 14. Burner means 17 of conventional construction, and having conventional burner fuel supply and controls (not shown), are provided for passing heated gases through the flue tubes to heat the bituminous material in the tank to a temperature sufficient to maintain it in a readily flowable condition suitable for spreading.

The bituminous material is commonly sprayed through a spray bar 21 which is mounted on the truck to extend crosswise thereof and which has a plurality of spray nozzles of conventional construction at spaced points therealong and which spray nozzles are preferably of the type having a built-in shut-off valve, indicated at 22. The valve actuators 23 are conveniently connected to a common operating rod 24 to enable simultaneous opening and closing of all of the valves on the spray bar. The spray bar is preferably of the full recirculating type having a main delivery passage indicated at 25 which communicates with the nozzles, and a recirculating or return passage 26 conveniently built into the spray bar, and which return passage communicates with the main pas-

sage adjacent the ends of the spray bar. As is also conventional, the spray bar may include hinged outer sections 21*a* which are connected to the main sections of the spray bar by a joint coupling 28, which coupling is so arranged as to enable folding of the outer sections. Material is supplied to the spray bars as through a manifold 31 having a main passage 32 that communicates with the main distributor passage 25 in the spray bars and a recirculating passage 33 which communicates with the recirculating passage 26 in the spray bar. A material supply conduit designated 35, herein shown closed by an end fitting 36, is provided for connecting the spreader apparatus to a bituminous material supply such as a stationary tank, or a tank type supply vehicle. In addition, the spreader apparatus commonly employs a delivery outlet conduit indicated at 38 and herein shown closed by an end fitting 39. The delivery outlet is adapted for delivering material from the pump either to another storage tank or to a hand-spray apparatus diagrammatically illustrated at 41, and which may comprise a spray nozzle 42 having a manual control valve 43 for controlling the flow to the spray nozzle, and which is used in connection with patch work and spreading bituminous materials on small or irregular areas.

A pump and valve means is provided for pumping fluid into and out of the tank and, in accordance with the present invention, a pump and valve assembly designated generally by the numeral 51 is mounted within the tank 12 so as to be heated by the fluid in the tank when the latter is heated by the aforedescribed heating system including the flues 15, 16 and burners 17. For this purpose, a pump enclosure housing 52, conveniently of tubular configuration, is mounted within the tank. The housing has an open outer end 52*a* which opens at an outer wall of the tank, conveniently the rear end wall 14, and an inner end 52*b*. The housing 52 is supported on the rear wall as by welding thereto in sealed relation to the tank and is supported at its inner end by any suitable means, such as by welding to an intermediate baffle wall 54. The baffle wall as shown extends crosswise of the tank and conveniently provides a support not only for the housing 52, but also for the flue tubes 15 and 16. However, the baffle wall is apertured at least adjacent the bottom of the tank so as to allow equalizing of the liquid levels at opposite sides of the baffle and at least some circulation within the tank. As will be seen from FIG. 4, the pump enclosure housing 52 is disposed in close proximity to the heating flue 16 to assure rapid and adequate heating of the pump assembly disposed in the enclosure housing.

The pump and valve assembly 51 is advantageously so arranged that it can be installed and removed from the housing without requiring draining of the tank 10. For this purpose, an adapter 56 is provided at the inner end of the housing 52 and, as shown in FIGS. 1 and 2, is mounted by fasteners 57 in an opening 58 in the baffle plate 54. As best shown in FIG. 2, the adapter has inlet and return passages 61 and 62 therein which are connected to tank inlet and return passages 63 and 64. Manually operable shut-off valves 65 and 66 are provided in the tank inlet and return passages 63 and 64 for shutting off communication with the tank. The valves are conventional shut-off valves and extensions (not shown) provided on the valve stems, which extensions are arranged so as to be accessible from the tank access opening, to enable closing of the valves in the event it is desired to remove the pump and valve assembly 51. For reasons pointed out hereinafter, the adapter is formed with an annular wall 67 and a face wall 68 around the openings 65 and 66 at the side adjacent the housing 52.

The pump assembly 51 includes a positive displacement pump 71, an inlet valve mechanism 72, and an outlet valve mechanism 73. The pump, inlet valve and outlet valve are assembled in a unit which also incorporates passageways for interconnecting the pump with the inlet and outlet valves and with the tank and distributor. In the embodiment shown, the casing for the pump assembly is formed in three sections including an inlet valve section 75, an intermediate pump section 76 and an outlet valve section 77. The inlet and intermediate casings have abutting flanges 78 and 79 which are detachably interconnected by fasteners 80 and the intermediate and outlet valve sections 76 and 77 have abutting flanges 81 and 82 which are interconnected by fasteners 83. The inlet casing section 75 has a head 85 at its inner end shaped complementary to the walls 67 and 68 of the adapter to be receivable therein for support of the inner end of the pump assembly on the adapter. Gasket means such as O-rings 88 and 89 are provided on the head and the embodiment shown, the casing for the pump assembly and the adapter when the pump assembly is inserted into the housing. Guide rods 91 are secured to the adapter 56 as by threaded engagement and extend longitudinally of the housing 52. Provision is made for guiding the pump assembly on the rods during insertion of the pump assembly into the housing and, for this purpose, openings 92 are provided in the flanges 78 and 79 and further openings 93 are provided in the flanges 81 and 82 for receiving the rods 91 and for guiding the pump assembly into position. The pump assembly is then clamped into position as by fasteners 94 which are threaded on the outer ends of the rod 91 and engage the flange 82 on the outer casing section. The outer end of the pump assembly is preferably supported by a means such as legs 70 attached to a reinforcing ring 60 welded to the outer end of the housing 52.

The pump 71 can be of any conventional construction, but is preferably of the axial flow screw type to provide pulsative free delivery of material. The pump has an inlet 96 adjacent the innermost end of the pump and an outlet 97 adjacent the outer end. The pump includes several screws 98 and 99 disposed in intersecting pump bores and, while the intersecting pump bores could be formed in the intermediate casing section 76, the pump is preferably formed separate from the casing sections 75–77 so as to be insertable and removable therefrom. In the form shown, the pump 71 includes pump housings 103 and 107 disposed in a bore 104 in the intermediate casing section 76. The pump housing 103 is sealed to the intermediate casing section 76 as by an O-ring 105 and is detachably locked in position as by a fastener 106. As shown in FIG. 1, a head 108 is sealed to the bore 194 in the intermediate pump casing section 76 by an O-ring 111 and defines a discharge chamber 112 at the discharge end of the pump. Similarly, the pump housing 107 at the inner end of the pump is spaced from the walls of the inner valve casing section 75 to form a pump inlet chamber 113.

A fluid supply passage 115 is provided for conveying fluid from the supply conduit 35 to the inlet of the pump. This passage is provided in the pump assembly and is advantageously formed by cored passages indicated at 115*a*, 115*b* and 115*c* in the casing sections 75–77 respectively. The inner end of the supply passage 115 communicates at a port 116 with the inlet valve chamber 117, and the supply passage 115 has a fitting 118 at its outer end for connection to the supply conduit 35. The inlet valve chamber 117 also has a port 119 communicating with the pump inlet chamber 113 and a port 121 that communicates with a passage 122 opening at the end of the head 85 on the pump assembly, in a position to register with the inlet passage 61 in the adapter.

The inlet valve 72 is of the three-way type which is movable between a first position communicating the pump inlet with the tank and a second position communicating the pump inlet with the supply passage 115. As shown, the valve includes a generally cylindrical valve member 125 having ports 125*a*, 125*b* and 125*c*. The valve member is rotatable from the position shown in FIG. 2 communicating the tank with the pump inlet, to a second position in which the port 125*a* communicates

with the supply passage 115 and the port 125*b* communicates with the pump inlet to thereby pass fluid from the supply passage to the pump inlet. The inlet valve 72 is operated from a point externally of the tank and, as shown, has an operating lever 128 which is connected through a link 129 that extends through the housing 52 to a point externally of the tank. A means such as an operating lever 131 is provided outside the tank for operating the inlet valve and, as shown in FIG. 3, the operating lever is connected to the link 129 and is pivotally mounted at 132.

The outlet valve mechanism 73 is arranged to control the flows of fluid from the outlet of the pump 71 to and from the passages 25 and 26 in the spray bar 21, and to the outlet conduit 38 and to a tank return passage 135 which leads back into the tank. The several discharge valving functions are advantageously combined in a single multi-port valve which is movable to different positions to control the flow from the pump to the various passages. As shown in FIG. 2, the return passage 135 is advantageously formed by cored passages 135*a* and 135*b* in the several casing sections 75–77. The inner end of the passage 135 extends through the head 85 at the inner end of the pump assembly and communicates with the return passage 62 in the adapter, when the pump assembly is assembled in the housing.

The valve 73 is advantageously physically mounted in the outlet casing section 77 and, as shown in FIG. 1, the multi-port valve is conveniently of the rotary type mounted in a valve chamber 138 in the outlet casing section 77. The valve includes a valve member 139 having a first section 139*a* and a second section 139*b* which are rotatable in unison but are hydraulically separated from each other by a dividing wall 139*c*. The valve is conveniently mounted for rotation upon axis generally paralleling the axis of the shaft 109 and has a valve stem 141 extending out of the valve chamber for operation by an external operator. Although the several ports and passages for the outlet valve are formed in the outlet casing section 77, the illustration of the actual physical arrangement of the ports and passages would require an excessively large number of views and the complete flow circuit including the outlet valving and passage arrangement is accordingly schematically illustrated in FIG. 5. The numbers used to identify the port and passages in FIG. 5 are the same as those used to designate the corresponding parts where they appear in the other views. More specifically, the outlet chamber 112 of the pump communicates through a passage 141 with an opening 142 at one end of the valve section 139*a* so that pump discharge pressure is always applied inside the valve section 139*a*. The valve casing includes a first set of ports 143*a*–143*d* which cooperate with the section 139*a* of the valve member. The port 143*a* is connected through a passage 144 to the outlet conduit 38, and the port 143*b* is connected through a passage 145 to the return passage 135 leading back to the tank. The port 143*c* is connected through a passage 146 to the manifold passage 32 leading to the main distributor passage 25 in the spray bar. Port 143*d* is connected to a transfer passage 147, which is otherwise connected as described hereinafter. The section 139*a* of the valve member has a single port 148 which is arranged as shown in FIG. 5. The valve casing also includes a second set of ports 151*a*, 151*b* and 151*c*. Port 151*a* is connected through a passage 152 to the return passage 135 and port 151*b* is connected through a passage 153 to the manifold passage 33 leading to the return passage 26 in the spray bar. The port 151*c* is connected to the aforedescribed transfer passage 147. Valve section 139*b* includes ports 155*a* and 155*b* arranged as shown in FIG. 5. A pressure relief valve 158 is preferably provided between the pump discharge passage 141 and the return passage 135, which relief valve is arranged to open and prevent build-up of excessive discharge pressure.

The valves are shown in the "spray" position in FIG. 5, in which fluid from the tank is delivered by the pump 71 to the spray bar 21. As shown, the inlet valve 72 is in a position to communicate the pump inlet with the tank so that fluid from the tank passes into the pump. The fluid from the pump is delivered through passage 141 and valve opening 142 to the section 139*a* of the valve and flows out through the port 148 to both the passages 146 and 147. Passage 146 leads to the main distributor passage 25 in the spray bar to feed the bituminous material thereto. Material is also advantageously supplied under pressure to the recirculating passage 26 in the spray bar. This is achieved by the transfer passage 147 passing fluid into the valve section 139*b* where it passes out through passageway 153 to the recirculating passage 26 in the spray bar. The valve member is movable from the position shown in FIG. 5 in which the arrows on the valve member are positioned at *a*, to successive positions indicated at *b*, *c*, *d* and *e* in FIG. 5. In the next position indicated at *b*, fluid is recirculated through the spray bar and back to the tank. More specifically, in the *b* position fluid under pressure is supplied from valve section 139*a* through port 143*c* and passage 146 to the main distributor passage 25 in the spray bar and fluid from the recirculating passage 26 in the spray bar passes through passage 153, and through ports 155*a* and 155*b* in the valve section 139*b* to the passage 152 leading to the return passage 135.

In the next or *c* position of the valve member 139, fluid from the pump is recirculated back to the tank. If the inlet valve is in the position shown in FIG. 5 communicating the pump inlet with the tank, then fluid from the tank will be recirculated to the pump and back into the tank to thereby circulate the fluid in the tank and obtain more uniform heating of the same. If the inlet valve is moved to its other position communicating the pump inlet with the supply passage 115, then fluid from the supply passage will be drawn through the pump and delivered into the tank. More specifically, in the *c* position, port 148 in valve section 139*a* communicates only with port 143*b* so that all of the pump discharge flows through passages 145 and 135 back to the tank.

The *d* position of the outlet valve is referred to as the hand spray position. In this position, fluid from the pump is delivered to the outlet conduit 38 for use in conjunction with the hand spray. However, since the hand spray can accommodate only a small portion of the total pump discharge, the valve is arranged so as to simultaneously return some of the fluid back to the inlet. Thus, in the *d* position port 148 in the valve section 139*a* communicates simultaneously with the ports 143*a* and 143*b*, to deliver a portion of the fluid to the hand spray and to return the remaining fluid back to the tank.

In the *e* position of the outlet valve, port 148 in the valve section 139*a* communicates only with port 141*a* so that all of the fluid from the pump is delivered to the outlet conduit 38. If the inlet valve is in the position shown in FIG. 5, this *e* position of the outlet valve can be employed to empty the tank through the outlet. Alternatively, if the inlet valve is moved to its other position communicating the pump inlet with the supply passage, the *e* position of the outlet valve can be employed to transfer fluid from the supply passage to the outlet passage, without passing through the tank on the truck.

Any suitable means may be provided for operating the outlet valve. As shown in FIG. 3, a sprocket 161 is operatively connected to the valve stem 141 and is connected through a chain 162 to a sprocket 163. The sprocket 163 is rotated through a lever 164 having a releasable pawl 165 movable into notches designated *a*–*e* to position the outlet valve accordingly.

The pump 71 is driven from a motor located externally of the tank. As diagrammatically illustrated in FIG. 5, the motor is conveniently of the hydraulic type indicated at 175 and which is connected through lines 176 to a pump 177. The pump may conveniently be driven at a speed correlative with the vehicle speed and, for example, may be connected through a power take-off to the vehicle

engine indicated at 178 in FIG. 4. In order to vary the quantity of material dispensed at any particular vehicle speed, the pump 177 may be of the variable displacement type which may be operated manually or otherwise to vary the displacement of the pump 177 for each revolution and hence to vary the speed of the drive motor 175 and the product pump 71 in relation to vehicle speed.

From the foregoing it is throught that the operation and construction of the apparatus will be readily understood. Since the pump assembly including the pump and valves are housed within the tank, they are heated by the material in the tank when the latter is heated so that the pump and valves can be heated even before starting the pump. Since the fluid passages extend alongside the pump and valve, the pump and valve assembly is moreover heated by the fluid circulated therethrough. With the arrangement disclosed, the pump assembly can be easily installed and removed from the housing in the tank and, when installed, will automatically effect a connection between the inlet and return lines on the pump assembly and the tank inlet and return lines. In the pump assembly, the valving functions are concentrated at the inlet valve 72 and the outlet valve 73 and the valves are operative independent of each other to control the various different flows to and from the pump.

While I have specifically described and illustrated an embodiment of the invention presently considered preferable by me, it is to be understood that various changes and modifications of the described embodiment may be made by those skilled in the art without departing from the scope of the invention as intended to be defined by the appended claims.

I claim:

1. In an apparatus for spreading bituminous materials and the like including a tank having means for heating the material therein, means for distributing the material, and pump means for pumping the material from the tank to the distributor means; the improvement comprising means defining a pump oven enclosure separate from the pump extending into said tank and opening at an outer wall thereof, and means detachably mounting said pump means in said pump oven enclosure for heating of the pump means by the heated material in the tank.

2. An apparatus according to claim 1 in which said means for heating the material in the tank includes heating flues extending through the tank and burner means for passing hot gases through the flues, said pump oven enclosure being disposed in said tank adjacent said flues but spaced therefrom.

3. In an apparatus for spreading bituminous materials and the like including a tank having means for heating the material therein, means for distributing the material, and a pump for pumping the material from the tank to the distributor means, the improvement comprising a pump enclosure housing extending into the tank and having an outer end opening at an outer wall of the tank and an inner end located inwardly of said tank, a pump assembly including said pump dimensioned for insertion and removal as a unit from said pump enclosure housing through said outer end of said housing, means detachably mounting said pump assembly in the housing, said pump assembly having inlet means at the inner end thereof communicating with the tank and outlet means adjacent the outer end of the pump assembly communicating with said distributor means, and means adjacent the outer end of the pump assembly for driving the pump.

4. An apparatus according to claim 3 including an inlet valve on said pump assembly adjacent the inner end thereof for controlling flow from the tank to the pump, and means extending from said inlet valve through said housing to a point external of the tank for operating said inlet valve.

5. An apparatus according to claim 3 including means in said pump assembly defining a material supply passage extending from a point external of said housing to the inner end of said pump assembly, an inlet valve on said pump assembly adjacent the inner end thereof for communicating said pump inlet means selectively with said tank and with said supply passage, and means extending from said inlet valve through said housing to a point external of said tank for operating said inlet valve.

6. An apparatus according to claim 3 including means operative when the pump assembly is mounted in said pump enclosure housing for sealing the interface between the inner end of the pump enclosure and the inner end of the pump assembly.

7. An apparatus according to claim 3 wherein said pump enclosure housing has tank inlet and return passages at the inner end thereof communicating with the tank, said pump assembly having a pump return passage extending from a point adjacent its outer end to a point adjacent its inner end, and means operative when the pump assembly is mounted in the pump enclosure housing for sealing the interface therebetween around said inlet and return passages.

8. An apparatus according to claim 7 including inlet and return shut-off valves in said tank selectively operable to shut off flow between the tank and the tank inlet and return passages to allow removal of the pump assembly without draining the tank.

9. The combination of claim 7 including inlet valve means on said pump assembly adjacent the inner end thereof for controlling flow from the tank to the pump inlet means.

10. An apparatus according to claim 3 including means on said pump assembly defining supply and return passages extending along the pump assembly from adjacent the outer to the inner end thereof, inlet valve means on the pump assembly adjacent the inner end thereof for communicating said pump inlet means selectively with said tank and said supply passage, and outlet valve means on said pump assembly adjacent the outer end thereof for communicating said pump outlet means selectively with said distributing means and said return passage.

11. An apparatus according to claim 3 wherein said means for mounting the pump assembly includes guide rods secured to said housing adjacent their inner end and extending toward the outer end of the housing, said pump assembly having means guidably supporting the pump assembly on the rods during movement into and out of the housing, and fastener means on the rods engaging the pump assembly to detachably secure the pump assembly in the housing.

12. In an apparatus for spreading bituminous materials and the like including a tank having means for heating the material therein, means for distributing the material, and a pump for pumping the material from the tank to the distributor means, the improvement comprising a pump enclosure housing extending into said tank and opening at an outer wall thereof, said enclosure housing having tank inlet and return passages therein communicating with the tank and opening into said housing, a pump assembly including said pump dimensioned for insertion and removal from said pump enclosure housing through said outer end of said housing, means for detachably mounting said pump assembly in said housing, said pump assembly having pump inlet and return passages opening at the outer side of the pump assembly in positions to register with said tank inlet and return passages when the pump assembly is mounted in the housing, means operative to seal the interface between the pump assembly and housing around said inlet and return pasages when the pump assembly is mounted in the housing, means for connecting the outlet of the pump with said distributor means, and means for driving said pump.

13. In an apparatus for spreading bituminous materials and the like including a tank,

a spray bar having a main flow passage for feeding material to the spray bar nozzles and a recirculating passage,

a pump and valve unit comprising casing means having a casing inlet passage, a casing return passage, a supply inlet passage, a distributor outlet passage, a distributor return passage and a discharge outlet passage each opening at the outer side of said casing means,

a pump in said casing means,

a first multiple position inlet valve in said casing means for controlling flow to the inlet of the pump and movable into a position communicating the pump inlet with the casing inlet passage and a position communicating the pump inlet with the supply inlet passage,

a second multiple position outlet valve in said casing means for controlling flow from the outlet of the pump and movable into a first position connecting the pump outlet to said distributor outlet passage and blocking flow through the distributor return passage; a second position connecting the pump outlet with the distributor outlet passage and connecting the distributor return passage to the casing return passage; a third position communicating the pump outlet with said discharge outlet passage; and a fourth position connecting the pump outlet with said casing return passage,

means for connecting said casing inlet passage and said casing return passage to the tank,

means for connecting said distributor outlet passage to said main passage in the spray bar and for connecting said distributor return passage to said recirculating passage in the spray bar,

and means for driving said pump.

14. An apparatus according to claim **13** wherein said pump is of the screw tye having intermeshing screws with the pump inlet adjacent one end of the screws and the pump outlet adjacent the other end of the screws, said inlet valve being located in said casing means adjacent the inlet end of the pump and said outlet valve being located in said casing means adjacent the outlet end of the pump.

15. An apparatus according to claim **13** including a pump enclosure housing extending into the tank and having an outer end opening at an outer wall thereof and an inner end located inwardly of said tank, and means removably mounting said pump and valve unit in said enclosure housing.

16. An apparatus according to claim **15** including a head on said casing means at the inner end thereof, said casing inlet and return passages extending through said head, and means for sealing the interface between said head and said enclosure housing around said casing inlet and return passages when the pump and valve unit is mounted in the housing.

17. An apparatus according to claim **15** wherein said casing inlet and return passages have ends opening adjacent one end of the casing means adjacent the inner end of the housing, said inlet valve being located adjacent said one end of the casing means and said outlet valve being located adjacent the other end of the casing.

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EVERETT W. KIRBY, *Primary Examiner.*