Oct. 25, 1966 L. P. HYNES ETAL 3,281,573

HEATING SYSTEM FOR ASPHALT EQUIPMENT

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Fig. 1.

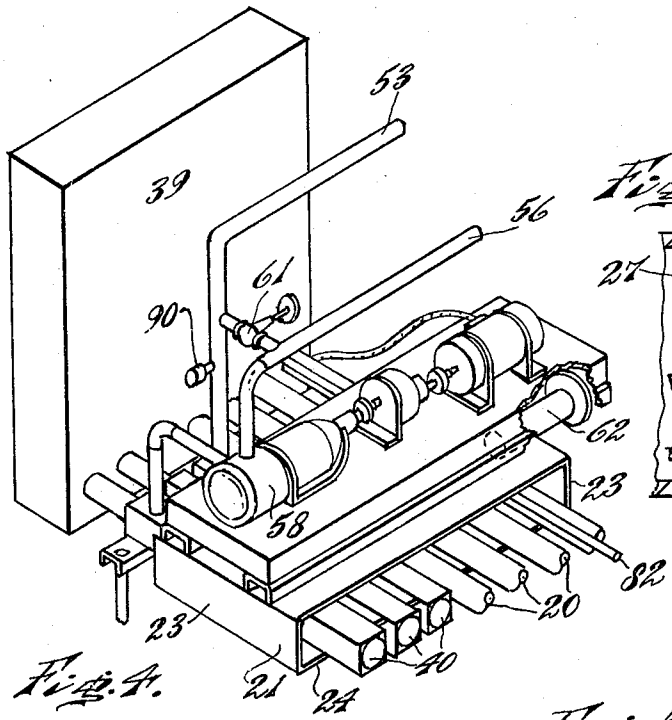


Fig. 2.

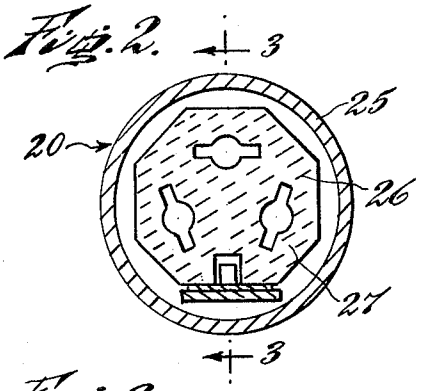


Fig. 3.

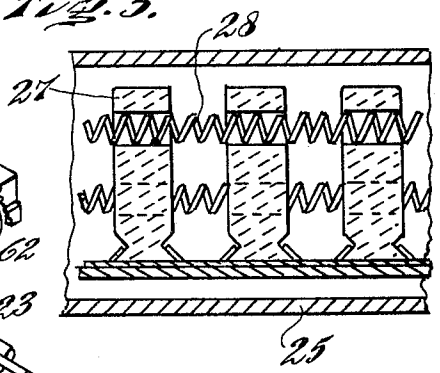


Fig. 4.

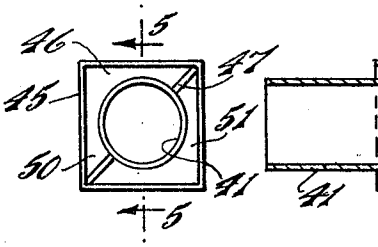
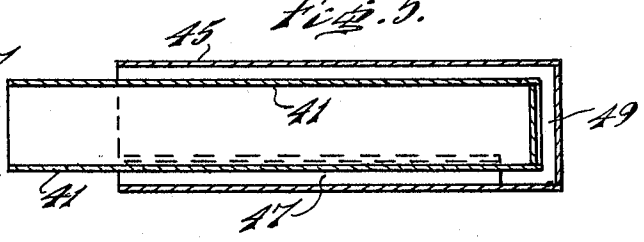


Fig. 5.



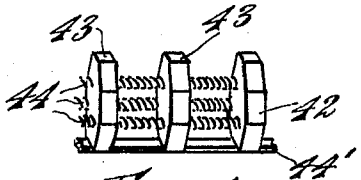


Fig. 6.

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HEATING SYSTEM FOR ASPHALT EQUIPMENT

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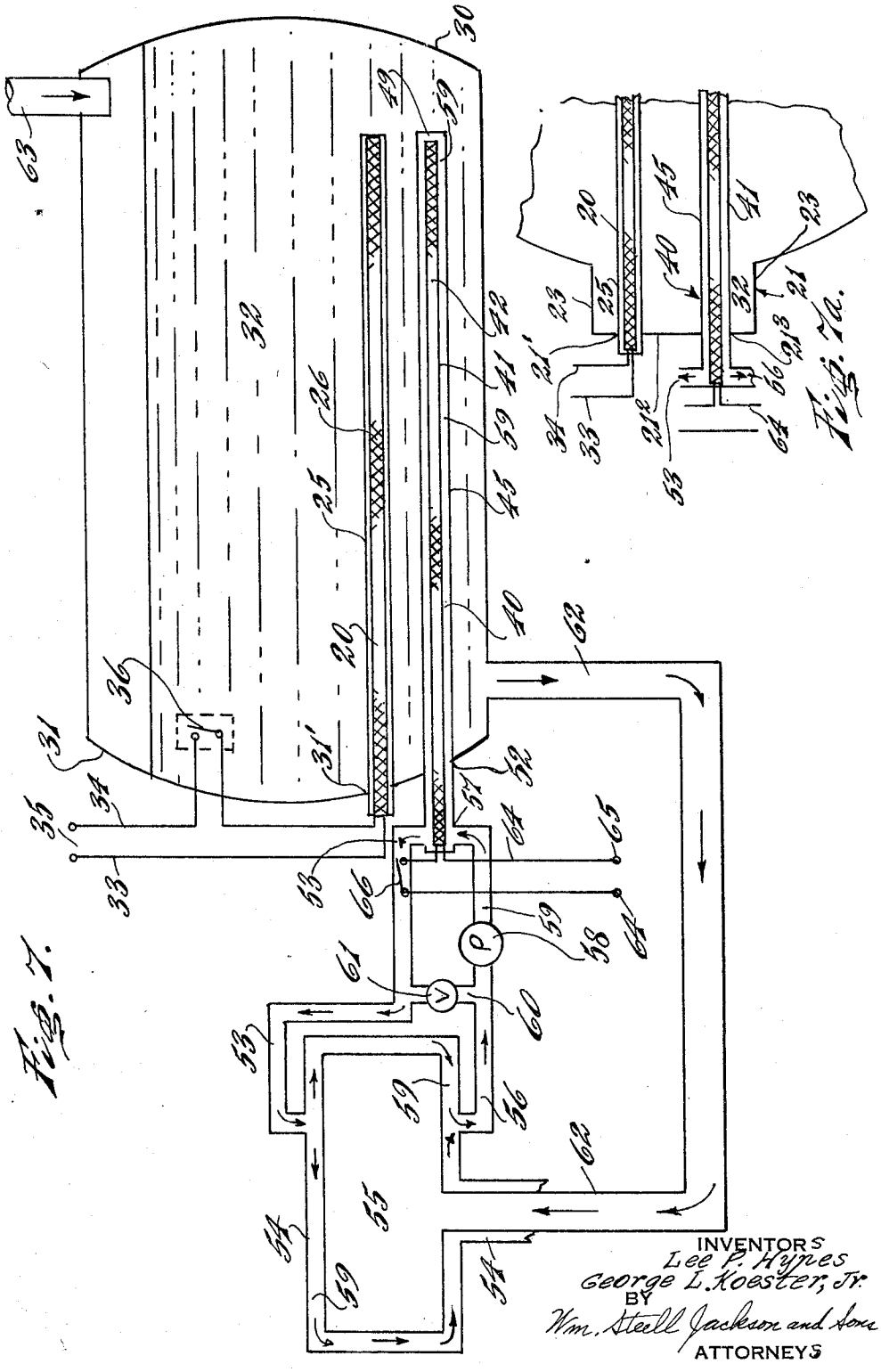


Fig. 1.

Fig. 2.

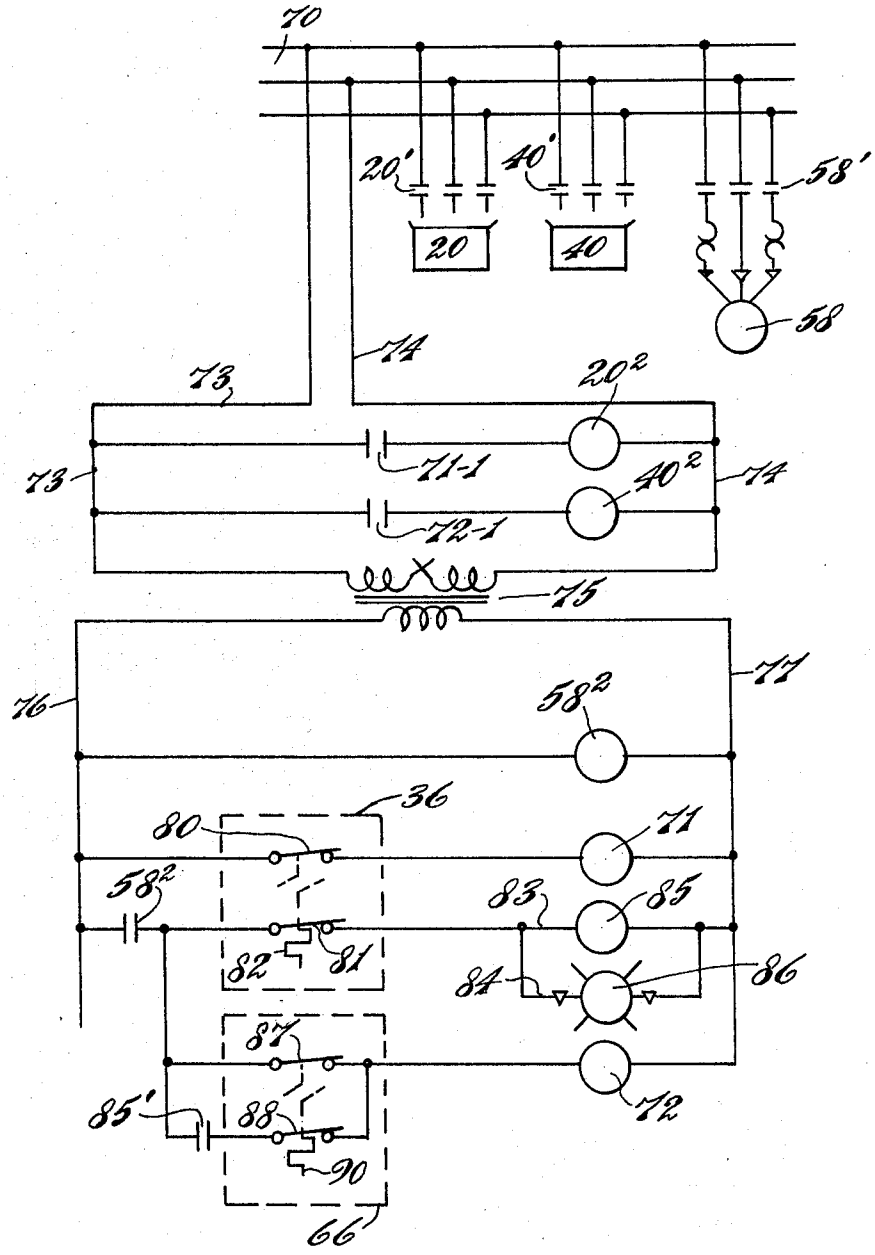
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HEATING SYSTEM FOR ASPHALT EQUIPMENT

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Fig. 8.



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HEATING SYSTEM FOR ASPHALT EQUIPMENT

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Filed Feb. 25, 1964, Ser. No. 347,222
6 Claims. (Cl. 219—326)

The present invention relates to heating systems and especially to heating systems for asphalt tanks and auxiliary equipment used in asphalt concrete plants.

A purpose of the invention is to heat asphalt in tanks and auxiliary equipment with a minimum of installed kw. of power.

A further purpose is to use a heat transfer fluid to selectively transfer heat to or from asphalt in a tank.

A further purpose is to use the asphalt in the tank as a heat reservoir to selectively receive or yield heat.

A further purpose is to utilize separate electric heaters in cooperation with the asphalt in the tank to selectively store or withdraw heat from the material in the tank.

A further purpose is to store surplus heat in a reservoir of material in a tank from a first heater and from a second selectively operated heater.

A further purpose is to selectively use all the heat from the first and second heaters to heat the asphalt in the tank.

A further purpose is to arrange the entire heating system into a common structure for partial insertion into a tank and for connection to auxiliary equipment.

A further purpose is to selectively by-pass the heat transfer fluid from the auxiliary equipment back to the tank in order to utilize the combined total heating components of first and second heaters for heating asphalt in a tank.

Further purposes appear in the specification and in the claims.

In the drawings we have chosen to illustrate a few only of the numerous embodiments in which our invention may appear, selecting the forms shown from the standpoints of convenience in illustration, satisfactory operation and clear demonstration of the principles involved.

FIGURE 1 is a partial perspective view of the heating system of the invention.

FIGURE 2 is a cross sectional view of the first heater of the invention.

FIGURE 3 is a longitudinal section taken on the line 3—3 of FIGURE 2.

FIGURE 4 is a cross section of the second heater.

FIGURE 5 is a longitudinal section taken on the line 5—5 of FIGURE 4.

FIGURE 6 is a perspective view of the heater element inserted in the heaters of FIGURES 4 and 5.

FIGURE 7 is a schematic diagram of the heating system of the invention.

FIGURE 7*a* is a fragmentary schematic drawing showing the heaters supported from a base secured to the tank wall.

FIGURE 8 is a schematic electrical wiring diagram of the system of the invention.

Describing in illustration but not in limitation and referring to the drawings:

In the mixing of asphalt and aggregates to make paving material known as "Asphalt Concrete," large storage tanks are used to hold an adequate supply of asphalt. Although these tanks may be insulated, they require heat to keep the asphalt material in a fluid condition sufficient for pumping to the external auxiliary mixing equipment. In addition, the asphalt must meet rigid temperature specifications and be sufficiently hot to blend properly with the aggregates, such as crushed stone and sand. Additionally, it is necessary to heat auxiliary external equipment associated with the tank which is used in the mixing process. This equipment includes pumps, pipe lines, weigh buckets, and mixers.

In the prior art, separate heating systems were used for respectively heating the asphalt in the tank and the associated external equipment. The demands for heat vary greatly between the two parts of the system, namely the storage tank and the external equipment, and often one part of the system requires little heat while the other part requires a larger amount of heat. Hence, it was necessary to have separate systems which could act independently to supply the required needs of the tank and the auxiliary equipment with the result that a large total connected kw. was necessary. This large total connected kw. load resulted in expensive first costs for power supply, equipment and demand charges for connected load whether used or not. In effect, two complete independent systems were required, each of which had to independently have capacity to carry the maximum load of each portion of the system.

The present system replaces the old expensive dual heating systems with a single system which uses two separate heaters submerged in a common storage tank with a heat transfer fluid jacket surrounding the second of the heaters and conduits connecting the fluid from the fluid jacket to the auxiliary external equipment for circulating the heat transfer fluid from the jacket within the tank to the auxiliary external equipment.

Controls are used to energize the first heater to heat the asphalt in the common tank. Above a certain temperature the second heater within the heat transfer jacket is inactive and the heat transfer fluid is circulated through the jacket to the auxiliary external equipment so that stored heat is withdrawn from the asphalt in the tank and transferred to the auxiliary equipment. In the event that the temperature of the asphalt in the tank drops below a given temperature, the second heater within the fluid jacket is energized, thus heating the transfer fluid from the second heater. The fluid is circulated to the auxiliary external equipment and returned to the jacket within the storage tank and any surplus heat from the second heater not required by the external auxiliary equipment is transmitted through the walls of the fluid jacket into the asphalt in the tank. In the event that the temperature of the asphalt in the tank continues to drop even though the first and second heaters are operating, the circulation of the fluid to the auxiliary equipment is stopped by opening a by-pass valve and by-passing the flow to the auxiliary equipment back to the tank. Under this condition, the heat from both heaters is entirely transmitted to the asphalt stored within the common tank.

The heating system broadly described above has the advantage of a low total kw. connected load with a resulting reduction in demand charges due to improved load factor. In addition, simplified construction, full utilization of equipment, and extreme flexibility of operation with close control of temperatures is obtained.

The system additionally lends itself to pre-assembly into a standard packaged unit which can be readily inserted in tanks of various sizes and connected to auxiliary external equipment as will be described.

Although the specification refers throughout to asphalt, it should be understood that the invention is equally applicable to any other fluid which must be heated for processing or for manufacturing purposes.

Referring now to the drawings, first heater **20** extends and is supported from a base **21** which consists of a top **22**, sides **23** and a bottom **24**. The heater **20** can be of any resistor type which extends within a tube. A suitable heater is shown in FIGURE 2 and corresponds to that shown in United States Patent 2,750,487, FIGURE 8, and comprises essentially a tube **25** having extending there-

in a heater element 26. The tube 25 is closed at its end projecting into an asphalt storage tank as will be later described. The heater element 26 consists of insulators 27 which support metal resistors 28 in insulated relationship from the tube 25. For specific details of the heater, reference is made to the above mentioned patent.

As seen in the schematic view of FIGURE 7, the heater 20 extends into a storage tank 30. The tank 30 may be of any suitable design having a wall 31. In the preferred embodiment of the invention as shown in FIGURE 7*a*, the base 21 of FIGURE 1 is welded or otherwise secured to an opening in wall 31 of tank 30, so that the asphalt or other material 32 within the tank is retained in a closed space defined by the box-like base 21 and tank 30. The tube 25 is sealed to the base 21 at 21′ in the base back wall 21^2. Alternatively, the tube 25 itself may be sealed to the wall 31 at 31′ and the base 21 eliminated, as shown in schematic FIGURE 7. Suitable electric leads 33 and 34 extend from the heater element 26 to a source of power 35. A temperature sensing switch 36 is submerged in the tank asphalt 32 and controls the circuit to the heater 20 to selectively energize or deenergize the heater.

A second electric heater 40 of a type shown in FIGURES 4 to 6 also extends into the tank 30 through one of the walls thereof. The heater 40 is of a type shown in United States Patent 2,775,682 and consists of a tube 41 surrounding a heater element 42 of the type shown in FIGURE 6. The heater element 42 has spaced insulators 43 which receive resistors 44 held in spaced relationship by strap 44′ within and from the tube 41 and each other.

A tube 45, desirably rectangular in cross section, as shown in FIGURE 4, but which may be permissibly round or other configuration in cross section, surrounds the tube 41 to form a space 46 between the tube 45 and tube 41. The space 46 in one embodiment, as shown in FIGURE 4, is divided by means of longitudinally extending fins 47 so that two separate spaces 50 and 51 are obtained along the tube 41, so that separate flows of fluid can occur in the space 46. The spaces 50 and 51 are manifolded at the innermost end of the heater at 49. In alternative embodiments, the fins 47 can be eliminated and the entire space 46 treated integral, with pairs of spaces 46 manifolded to provide separate flows.

Control box 39 suitably receives the ends of heater tubes 25 and 41 and has located therein control switches, bus bars, and wiring circuits for the electrical and control equipment in the system.

In the preferred embodiment, the tube 45 extends through and is sealed to the back wall 21^2 of base 21 at 21^3 as seen in schematic FIGURE 7*a*. In an alternative embodiment, as seen in schematic FIGURE 7, the tube 45 is extended through the tank wall at 52, and is suitably sealed thereto, and passes to a conduit 53 which is connected to suitable jackets 54 or other heat exchange units associated with auxiliary equipment 55. Return conduit 56 extends from jackets 54 to tube 45 and connects therewith at 57 to space 51 thereof.

A pump 58 is inserted in line 56 and acts to circulate a heat transfer fluid 59 such as oil throughout tube 45, conduit 53, jacket 54 and return conduit 56. A by-pass line 60 extends between conduit 53 and return conduit 56 and has connected therein by-pass valve 61.

An asphalt supply line 62 extends from the storage tank 30 to the auxiliary external equipment 55 and conducts asphalt from the storage tank to the equipment for use therein. A suitable inlet 63 is provided for filling tank 30 with asphalt. Asphalt flows in line 62 under the influence of either gravity or a pump.

Heater 40 extending within tube 41 is connected through leads 64 to a suitable source of power at 65. A switch 66 having a temperature controlled element 90 as seen in FIGURE 8 extends into the circulating heat transfer fluid 59 at a suitable location, for instance conduit 53, and controls the energization and deenergization of heater 40.

Referring to FIGURE 8, we see there a wiring diagram showing the schematic electrical circuitry of one form of the invention. Electrical power leads 70 from a suitable source of electric power which may be, for instance, a three phase system, are connected to heaters 20 and 40 and to pump 58 through suitable switch gear 20′, 40′ and 58′. Relay coil 20^2 of switch gear 20′ is connected in series with normally open relay contacts 71–1 across leads 73 and 74. Relay coil 40^2 of switch gear 40′ is connected in series with normally open relay contacts 72–1 across leads 73 and 74. Leads 73 and 74 are connected to the primary of step-down transformer 75 and leads 76 and 77 connect to the secondary of the transformer 75. In the event that the electrical power source is of a suitable voltage to supply leads 76 and 77, no transformer 75 will be used.

Relay coil 58^2 is connected across leads 76 and 77. Tank temperature switch 36 includes switches 80 and 81 which are individually adjustable for temperature settings. Switches 80 and 81 are operated by a conventional prior art temperature sensing control 82. Temperature control 36 is of the type which has separate temperature settings for switch 80 and switch 81 so that these switches are respectively closed and opened at given temperature settings.

Switch 80 is connected in series with tank switch relay coil 71. Switch 81 is connected in series through switch gear contact 58^2 of switch gear 58′ and parallel circuits 83 and 84 through control relay coil 85 and pilot light 86. Temperature switch 66 includes switch 87 and switch 88 and temperature sensing control 90. Switch 66 is of a conventional prior art type similar to switch 36 wherein the individual switches 87 and 88 can be individually set to close and open at given temperatures.

Switch 87 is connected in series through switch gear contact 58^2 through relay coil 72 across leads 76 and 77. Switch 88 is connected in series through switch gear contact 58^2 and normally open relay contacts 85′ and relay coil 72 across leads 76 and 77.

In operation, asphalt or other material is loaded into tank 30 to a suitable height through inlet pipe 63. The temperature of the asphalt is sensed by temperature switch 36, which is set at suitable temperature levels. For instance, switch 80 may be set to close at 325 degrees or below and open at slightly above 325 degrees Fahrenheit. Switch 81 may be set, for instance, to close at 310 degrees or below and to open at slightly above 310 degrees.

Assuming the temperature of the asphalt is below 325 degrees for purposes of illustration, the circuit to heater 20 from source 35 will be closed and heater 20 will be energized and pass heat from the resistors 28 through tube 25 to the asphalt in reservoir 32. As long as the temperature of the asphalt is below 325 degrees heater 20 will continue to be energized. If the temperature of the asphalt drops below 310 degrees, switch 81 will close energizing relay 85 and pilot light 86. The illumination of pilot light 86 will signal to the operator that the temperature within the tank is lower than desired for proper operation. In order to prepare the system to overcome this condition, the operator will open by-pass valve 61 to achieve results which will be more fully described.

Tube 45 surrounding heater 40 encloses heat transfer fluid 59 which surrounds temperature switch 66 in conduit 53 which has a temperature sensing element 90 immersed in the heat transfer fluid 59. The heat transfer fluid 59 is constantly circulated by pump 58 through conduit 46 in tube 45 along heater 40 which is inserted into tank 30 and in return through conduit 51 of tube 45 into conduit 53, through jacket 54, through return conduit 56 back to pump 58. By-pass valve 61 will normally be closed.

The temperature sensing switch 66 will sense the temperature of the circulating fluid 59 and, for instance, will have a setting of 300 degrees on switch 87 and 400 degrees on switch 88. Switch 88 will normally be closed because the fluid is normally circulated at 300 degrees.

The fluid will normally circulate above 300 degrees because heater **20** is operating to maintain the temperature of the asphalt reservoir **32** at a temperature above 325 degrees. All illustrated temperatures are in degrees Fahrenheit.

In the event that the temperature in the circulating fluid falls below 300 degrees, switch **87** will close energizing heater **40**. Heater **40** will act to heat the transfer fluid **59** in tube **45**, the walls of which are in contact within tank **30** with asphalt reservoir **32**. The spaces **50** and **51** of tube **45** connect externally to jacket **54** through conduits **53** and **56**. The circulating fluid will be heated by heater **40** to 300 degrees. Heater **40** will maintain the fluid at this temperature in the event that insufficient heat is absorbed from the asphalt reservoir **32** by the circulating heat transfer fluid **59**.

In the event the temperature of asphalt reservoir **32** drops below 310 degrees, switch **81** closes, energizing relay coil **85** and pilot light **86**. When relay coil **85** is energized, contact **85'** will close to change the temperature setting of switch **66** from the 300° setting of switch **87** to the 400° setting of switch **88**.

Pilot light **86** will illuminate to signal the operator to open by-pass valve **61** to by-pass the circulating heat transfer fluid **59** from conduit **53** to return conduit **56**. This will direct the total heating capacity of heater **40** to heating the asphalt reservoir **32** by absorption of the heat from the circulating fluid through the walls of tube **45**.

The temperature in asphalt reservoir **32** will continue to rise under the influence of the combined heat capacity of heaters **20** and **40**. Above 310 degrees, switch **81** opens, interrupting the circuit to relay **85** and pilot light **86** extinguishing pilot light **86** and opening the circuit to switch **88**. This will signal the operator to close by-pass valve **61** whereby circulating fluid **59** will pass from tube **45** into jackets **54** and return therefrom. Switch **87** will be open since the temperature will be above 300 degrees and the circuit to heater **40** will open, deenergizing heater **40**. Under these conditions, the circulating fluid **59** will transfer heat from the asphalt reservoir **32** to the jackets **54**. The cycle will then be ready for another operation when necessary.

In view of our invention and disclosure, variations and modifications to meet individual whim or particular need will doubtless become evident to others skilled in the art, to obtain all or part of the benefits of our invention without copying the structure shown, and we, therefore, claim all such insofar as they fall within the reasonable spirit and scope of our claims.

Having thus described our invention what we claim as new and desire to secure by Letters Patent is:

1. A heater system for heating liquid material in a tank and auxiliary equipment external to the tank comprising, first means for heating liquid in the tank, second means submerged in the liquid within the tank including a heat transfer fluid, a jacket containing the heat transfer fluid, an electric heater selectively energized in association with the jacket, means for passing the heat transfer fluid through the jacket to the external equipment, and control means for selectively energizing the electric heater when the temperature of the material in the tank falls below a first given temperature and for selectively deenergizing the electric heater when the material in the tank rises above a second given temperature, whereby heat is transferred from the tank material to the external equipment when the electric heater is deenergized and heat is imparted to the tank material from the electric heater when the electric heater is energized.

2. A heating system of claim **1**, in combination with heat transfer fluid by-pass means for by-passing the heat transfer fluid away from the external equipment back to the tank.

3. A heating system of claim **2**, in combination with means for dictating when the material in the tank has dropped below a third given temperature and the by-pass means are to be activated.

4. A system for heating material in an asphalt concrete plant having a tank for storing the asphalt and auxiliary equipment external to the tank for processing the asphalt comprising, first tubes extending into the tank and submerged in the asphalt and containing first electric heaters, second tubes extending into the tank and having second electric heaters within the tubes, third tubes in association with the auxiliary equipment and extending into the tank and containing a heat transfer fluid, said third tubes surrounding said second tubes containing the second electric heaters, control means for operating the first heaters and circulating the heat transfer fluid between the tank and auxiliary equipment when the asphalt in the tank is above a first given temperature whereby heat is supplied from the first heaters directly to the asphalt in the tank and indirectly to the auxiliary equipment through the fluid in the third tubes, and for additionally operating the second heaters to heat the heat transfer fluid whereby heat is transferred to the asphalt in the tank and the external equipment when the asphalt falls below the first given temperature, the asphalt in the tank transferring heat to the heat transfer fluid above the first given temperature and the asphalt in the tank receiving heat from the heat transfer fluid below a given temperature.

5. A system of claim **4** in combination with by-pass means for by-passing circulation of the heat transfer fluid which flows in the third tubes away from the auxiliary equipment when the asphalt temperature falls below a second given temperature.

6. A system of claim **4**, wherein the first tubes and first heaters, the second tubes and second heaters, the third tubes and the control means are supported from a common base and form an integral unit.

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