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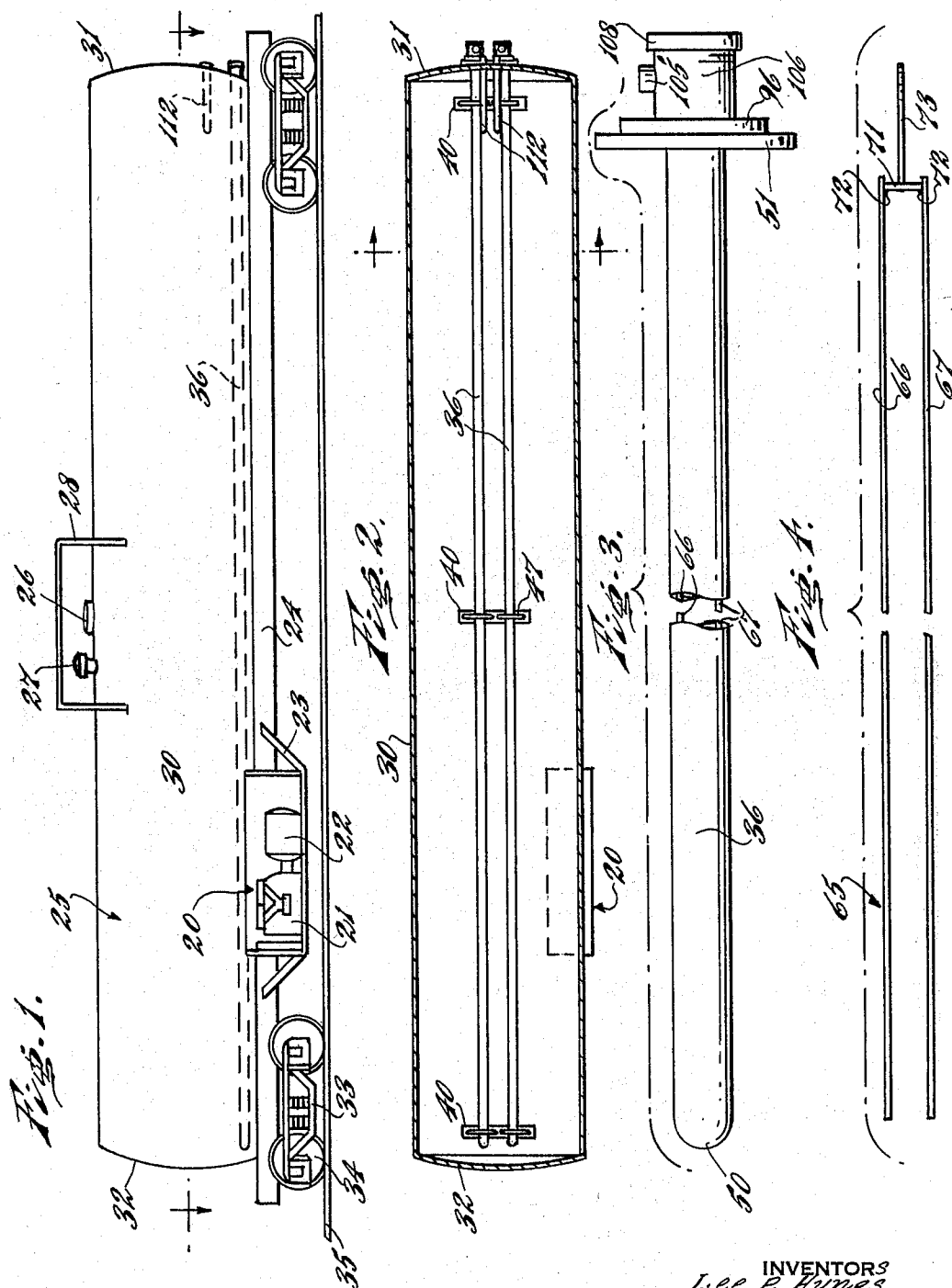
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3,286,079

TANK TRANSPORT HEATER

Filed April 23, 1964

3 Sheets-Sheet 1



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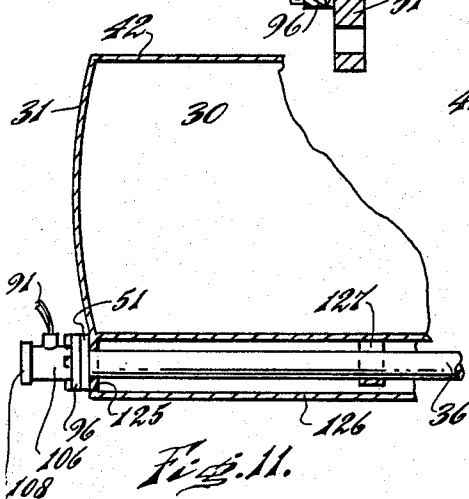
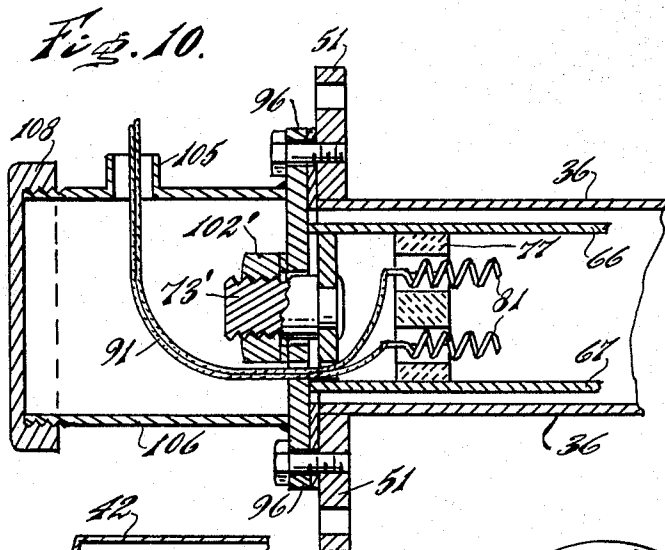
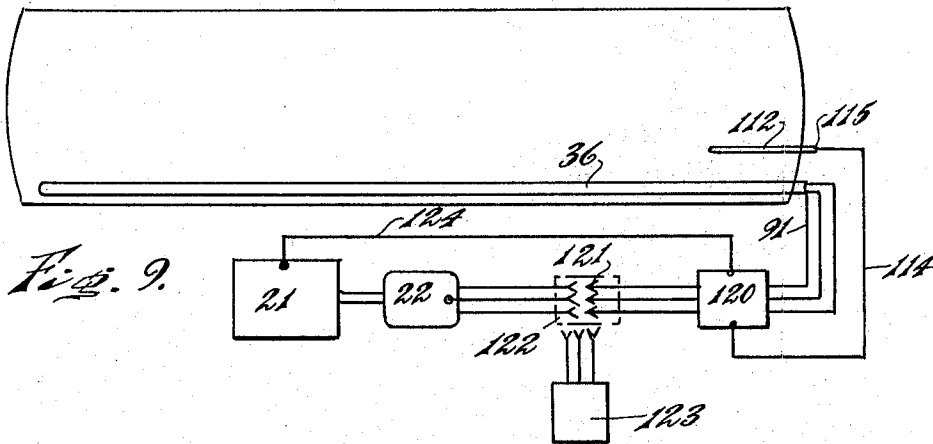
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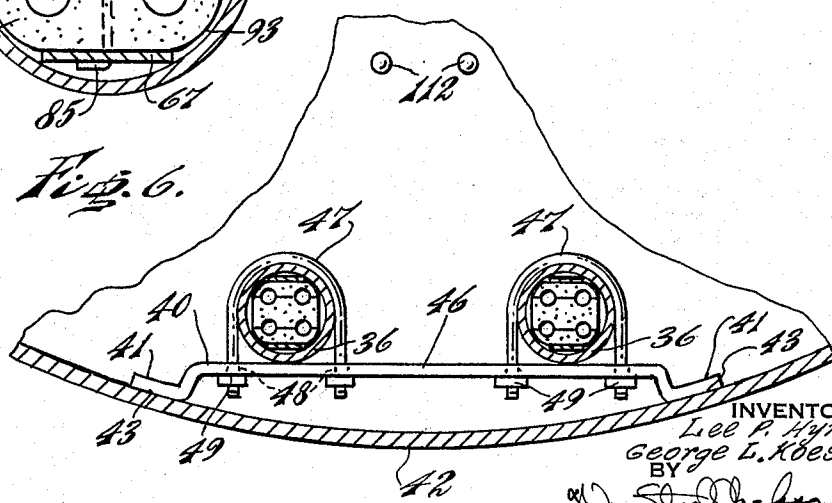
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3,286,079

TANK TRANSPORT HEATER

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The present invention relates to electric resistance heaters and particularly to heaters for tank transports.

A purpose of the invention is to heat fluid within tank transports, including railroad tank cars and tank trucks, during transit and storage.

A further purpose of the invention is to electrically heat fluid within tank transports selectively from self-contained generating equipment mounted on the tank transport or from public utility sources when the transport is halted.

A further purpose is to constantly maintain fluid in tank transports within elevated temperature ranges during transit and storage to avoid the need for prolonged reheating from a cold state at the unloading terminal.

A further purpose is to support an electric heater in a manner within the tank transport whereby the heater is not damaged by severe jolts, humps, or shocks.

A further purpose is to support an electric heater within a tank transport wherein the heater resistor is shielded from the fluid contained within the tank transport.

A further purpose is to provide means for easy assembly and disassembly of the electric heater within the tank transport without draining the tank.

A further purpose is to load a car with fluid at a maximum temperature at its point of origin, to maintain the fluid at an elevated temperature throughout its transport and subsequent storage at its destination, and to unload the tank contents at the destination at an elevated temperature without reheating.

A further purpose is to insulate a tank transport to minimize heat loss enroute and during storage.

A further purpose is to support the resistors within the heater by insulators suspended from a structural frame slidably supported within a tubular enclosure and longitudinally supported from the tank head.

A further purpose is to support the structural frame from the tank head in a resilient manner.

A further purpose is to resiliently support the insulators from the structural frame.

A further purpose is to resiliently support the resistors at a plurality of spaced longitudinal locations to absorb longitudinal shock on the resistors.

A further purpose is to use a longitudinally resilient resistor in combination with resiliently supported insulators.

A further purpose is to use a plurality of spaced insulators to longitudinally grip and support the resilient resistors.

A further purpose is to individually longitudinally support the insulators from a frame.

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 an elevational view of a railroad tank car equipped with the heater of the invention.

FIGURE 2 is a plan sectional view with the upper half of the tank car removed showing the heater tubes extending longitudinally within the car.

FIGURE 3 is an enlarged fragmentary view of the heater tube and terminal support.

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FIGURE 4 is a fragmentary plan view of the insulator support frame of the invention.

FIGURE 5 is an axial section through the heater tube of the invention.

FIGURE 6 is a fragmentary axial section of the tank transport bottom showing the tubes and tube support brackets.

FIGURE 7 is an enlarged fragmentary vertical section showing the heater and heater shock absorber mounted in the end of a tank transport.

FIGURE 8 is a fragmentary vertical section of the end of the tank transport showing a temperature sensing instrument well.

FIGURE 9 is a block diagram showing the electrical arrangement for controlling the heater within the tank.

FIGURE 10 is a view similar to FIGURE 7 showing an alternative embodiment of the invention.

FIGURE 11 is a fragmentary longitudinal vertical section of another alternative embodiment of the invention, showing the heater outside the tank.

FIGURE 12 is an end elevation of the embodiment shown in FIGURE 11.

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

Extensive use of tank transports is made for transporting liquids and solids which become liquid at elevated temperature. These transports include railway tank cars and highway tank trucks. The fluids being transported are often highly viscous or even solid at reduced temperature and require heating during the loading and unloading operation, particularly during cold weather but in some instances even in comparatively warm weather. Such materials include heavy oils, fats, greases, waxes, pitch, asphalt and other chemical compounds. Solids which become fluid at elevated temperatures include chocolate, paraffin and sulphur. When the tank transports are loaded at the producing factories or from large storage reservoirs, the material is readily preheated as desired from stationary means which often are steam or electric heaters located within the storage tanks. The conveying pipe lines, pumps and the like used to move the fluid into the tank transports are also suitably heated by stationary heaters. Subsequent to the car loadings and during transport, the tank fluid contents frequently become chilled and hence highly viscous or solid so that in their cold state they cannot be unloaded at their destination.

In prior art efforts to heat the fluid for unloading, cars were equipped with internal or external steam coils or heaters adapted to be supplied from a stationary steam generator located at the unloading point. Steam was introduced into the steam coils but even under the most favorable conditions, it would take a relatively long period to warm the contents of the tank to a sufficiently high temperature. This required long period of heating is due to the relatively large volume of the tank transport and to the fact that many materials have poor heat conduction capacities which do not readily distribute the heat from the steam coils. It is not unusual for the car to require heating for a period of several days at its destination to get the lading into a sufficiently fluid condition to achieve the unloading. This ties up the tank transport from service and incurs heavy demurrage charges and causes congestion on sidings and freight terminals. Additionally, cars are often unloaded at places where steam is not readily available, such as rural construction sites, road building and tunnel or bridge projects. In these instances, it is often necessary to obtain portable steam boilers and to hire an operator for the sole purpose of heating up the tank car. This problem of heating tank cars has been a serious economic handicap.

In the present invention, the car after loading at maximum temperature at its point of origin, is kept at an ele-

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vated temperature during transport by an electric heater located within the tank energized by a self-contained power generator mounted on the car. After arrival at the car's destination and prior to unloading of the tank, the heater continues to operate from electrical energy supplied by the power generator on the car, or in the event public utility power is available, such source may optionally be used. Since the fluid contents of the tank are never allowed to become chilled, there is no need to reheat the tank contents before unloading, so that the subsequent long delay in unloading at the point of destination is eliminated.

In the present invention, a heater is supported within a tank in a special manner so that the normal jolts, shocks and humps imparted to a tank do not damage the heater. For instance, it is conventional in railroad yards to selectively assemble the cars during a yard operation by a so-called humping of the cars. In this operation, the cars are pushed by a prime mover to the top of an inclined plane and then individually allowed to travel by gravity down the decline into selected sidings from within a group of sidings, by remote control switches. The cars are brought to rest by impact against either a fixed abutment or preceding stalled cars and the jolt imparted to the car at this point is a substantial one. The heater of the present invention is able to withstand such jolts and shocks without damage since the heater elements, including the resistors and insulators, are resiliently supported from a frame which in turn is connected to an end of the tank. Optionally, a shock absorber which acts in either direction with respect to longitudinal movement of the car, is used to absorb impact from such severe car jolts.

Referring to the drawings, a self-contained power generator 20 comprising suitably an internal combustion engine 21 and an electric generator 22 is suspended in suitable fashion by a framework 23 from the frame 24 of a tank transport 25 which in this case is shown as a railroad car but which may optionally be any form of tank transport including a truck tank transport. The power generator 20 may optionally be located at any suitable position on the tank transport, including on the top of the tank, and would desirably be weatherproofed.

The tank car 25 is loaded through conventional openings 26 with vents 27 providing for air escape in loading. A suitable railing 28 surrounds cover 26 and vent 27. The tank itself has a longitudinally extending body portion 30 and end faces 31 and 32. Well known railway trucks 33 support wheels 34 riding on tracks 35. The tank is desirably thermally insulated by a suitable insulating jacket.

Extending longitudinally within the tank and supported therein, desirably near the bottom, are heater tubes 36 suitably two in number which enter through end face 31. The tubes are slidably supported from brackets 40 best seen in FIGURE 6 which comprise feet 41 suitably joined to the cylindrical car wall 42 by for instance welding at 43. The brackets 40 have a web portion 46, which supports tubes 36. U-bolts 47 surround the tubes 36 and pass through holes 48 in web 46. Nuts 49 secure the U-bolts 47 to the bracket. The nuts 49 are adjusted to securely hold the tubes 36 to the bracket while allowing longitudinal movement of the tubes due to thermal expansion and contraction. The tubes 36 extend for any desired distance longitudinally of the car and as for instance seen in FIGURE 2 can extend in close proximity to opposite end wall 32. Tubes 36 are closed at one end 50 as best seen in FIGURE 3 and sealed at the other end to a flange 51 at position 52 as by welding, as best seen in FIGURE 7. The flange 51 is bolted to plate 53 which is a flange on tube 54 welded at 55 to end face 31. Plate 53 is welded to tube 54 at 54'. A suitable annular opening 56 in end face 31 permits extension of tube 36 through the end wall. A gasket 57 extends between flange 51 and plate 53 and provides a tight seal. Cap screws 58 extend through holes in flange 51, gasket 57 and plate 53 and are held by nuts 60.

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An alternate method of mounting tube 36 in the tank is to weld or otherwise secure the tube 36 directly to the end face 31 at annular opening 56. In this case, plate 53, tube 54, gasket 57, and bolts 58 along with nuts 60 are eliminated.

Extending within the tube 36 is a frame 65 as best seen in FIGURE 4 which includes flat longitudinally extending side plates 66 and 67. A support piece 71 is secured to the plates 66 and 67 at an endmost position as by welding at 72. A threaded rod 73 is anchored in plate 71 through 76 by integral extension 74 welded at 75 as best seen in FIGURE 7. As seen in FIGURES 5 to 7, plates 66 and 67 are spaced so they can extend within tube 36 in close proximity to the inside wall of the tube. Positioned between the plates 66 and 67 are a plurality of matching transversely extending insulators 77, 78 and 80 which support longitudinally extending resistors 81. The insulator 78 is substantially rectangular in form as seen in FIGURE 5 and of a thickness of suitable proportion as seen in FIGURE 7. Semi-cylindrical depressions 82 which are of a size substantially that of the cross section of the resistors 81 extend longitudinally through the insulators. Insulators 77 and 80 which are of identical construction and have matching semi-cylindrical depressions 83 which cooperate with depressions 82 to resiliently grip the resistors 81. The resistors are suitably of a helically wound wire or ribbon of a cross sectional area which provides the desired electrical resistance to provide an adequate heat output for the heater. The resistors are of any well known prior art type and for instance could be similar to that described in Hynes United States Patent 2,963,539, issued December 6, 1960, and may be electrically connected to each other in series or in parallel to provide a suitable electrical circuit.

The insulators when joined in the manner described, and shown in FIGURES 5, 6 and 7, are held to the frame plates 66 and 67 by strap 84 shown in FIGURE 5 which extends through a corresponding opening throughout the center of the insulators through openings in plates 66 and 67. The strap 84 is bent at each end at 85 to retain the insulators within the frame 65. The insulators are spaced longitudinally along the frame 65 at suitable intervals to provide proper support and restraint to the resistors 81 both longitudinally of the tube and radially within the tube. This prevents sagging of the resistors 81 between insulators whereby the resistors would touch each other or the walls of the tube 36. It will be seen that by this arrangement of insulators, the frame 65 individually supports each series of insulators at a given longitudinal location and no buildup or pileup of insulator weights is created due to longitudinal shock or impact.

As seen in FIGURE 7, the resistors 81 have terminal connections 90 connecting to insulated leads 91 which pass through an opening 92 in support plate 71. Insulators 77 and 80 have curved corners 93 which clear the inside wall of tube 36. The insulators are supported longitudinally within the tube by the frame 65 which in turn is secured to threaded rod 73. Threaded rod 73 extends through circular opening 95 in buffer plate 96 which is suitably a disc-like structure having angularly spaced holes 97 that receive cap screws 98 threaded into tapped holes 100 in flange 51. Gasket 57' is positioned between plates 51 and 96 to seal the joint. A compressed helically wound compression spring 101 surrounds the threaded rod 73 and abuts at one end against support plate 71 and at the other end against buffer plate 96. A second helically wound compression spring 102 surrounds threaded rod 73 on the side of buffer plate 96 opposite that of spring 101 and a lock nut 103 threadily engages rod 73. By means of the lock nut, the desired precompression can be imparted to both springs to absorb subsequent impacts from the frame 65. A washer 104 extends along the nut 103 and acts as a compression surface against one end of helically wound spring 102. Spring 102 bears at the end opposite washer 104 against

buffer plate 96. Leads 91 extend through opening 105 in buffer plate 96 and on out through bushing 105' in terminal housing 106 which is suitably secured as by welding at 107 to buffer plate 96. A threaded cover 108 engages threads 110 on the terminal housing 106 which is suitably circular in cross section.

In an alternative embodiment of the invention as seen in FIGURE 10, the compression springs 101 and 102 are eliminated, and the threaded rod 73' is rigidly secured to plate 96 by lock nut 102', and plates 66 and 67 abut against plate 96. This form may be used where the resiliency of the heater construction itself is sufficient to absorb shocks.

In some instances, it may be desirable to install the heater tubes outside the tank wall rather than within the tank, as shown in FIGURES 11 and 12. A support plate 125 is welded or otherwise secured to the tank and the tubes 36 are supported therefrom in a similar manner to that shown in the embodiments of FIGURE 7 or 10. Support plate 125 corresponds to plate 53 in FIGURE 7. The heater itself is identical to that described above. A protective shield 126 surrounds the tubes 36 and serves to structurally protect the tubes and additionally to confine the heat adjacent to the tank wall 42. Shield 126 is desirably thermally insulated to prevent heat loss. Longitudinally spaced brackets 127 support the tubes from the tank in a manner similar to that of brackets 40.

A temperature sensing tube well 112 as seen in FIGURE 8 of any conventional type extends through end wall 31 of tank 30 and is secured thereto as at 113 by a weld or the like. A temperature sensing device 115 extends within well 112 and electrical leads 114 are connected thereto.

Referring now to the schematic wiring diagram of FIGURE 9, heater 36 is connected through leads 91 through switch gear 120, plug 121 and receptacle 122 to generator 22 which in turn is driven by direct coupled internal combustion engine 21. Receptacle 123 serves as an auxiliary source of power from a public utility. Plug 121 is manually selectively connected to electrical generator receptacle 122 or public utility receptacle 123 depending on which source of power is desired.

Switch gear 120 is connected through leads 114 to temperature sensing instrument 115. The temperature sensing instrument 115 extending within well 112 will signal the temperature of the contents of tanks 30 electrically through leads 114 to switch gear 120.

Conventional prior art devices are used to achieve the switching functions as well as the signal functions.

Considering the operation of the heater, temperature sensing device 115 within well 112 senses the temperature of the fluid within tank 30 in the well known prior art manner and electrically signals such temperature through leads 114 to switch gear 120. Switch gear 120 will interrupt the current, from either the public utility receptacle 123, or the electrical generator receptacle 122, when the temperature of the tank contents is above a normally set maximum. Additionally, at maximum temperature, switch gear 120 will signal internal combustion engine 21 through leads 124 to reduce engine speed to idle.

When the temperature of the tank contents drops to an intermediate preset temperature, the sensing device 115 signals switch gear 120 through leads 114. Switch gear 120 closes the circuit to heater 36 from the power source. In addition, switch gear 120 will signal internal combustion engine 21 to increase engine speed in the event that it is being used to supply power. Increase in engine speed of engine 21 increases electrical output of generator 22 to heater 36.

In the event the temperature of the tank contents continues to fall to a third preset temperature, the temperature sensing device 115 signals switch gear 120, which in turn signals engine 21, when being used, to further increase engine and power output. The engine speed will continue to be regulated in like manner depending on the temperature of the tank contents.

In the event that public utility power is being used, heater 36 will be selectively energized by the action of switch gear 120 on signal from temperature sensing device 115.

The engine 21 and generator 22 may be chosen to produce any desired full load. A typical installation may have an engine operating at an idling speed of 1200 r.p.m. with no connected load, an intermediate speed of 1800 r.p.m. with 10 kw. connected load, and a full load speed of 2400 r.p.m. with 20 kw. connected load.

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 in combination with a tank transport having a generally cylindrical longitudinally extending tank with a cylindrical wall and opposing end faces, wherein the heater comprises a tube extending longitudinally of the tank adjacent the tank wall and in heat exchange relationship to the tank contents, a seal between the tank and the tube, a heating element extending longitudinally within the tube and supported therein, said heating element including a resistor, insulators surrounding and supporting said resistor, a longitudinally extending heater frame within the tube and supporting the insulators, fastening means extending through the heater frame for securing said insulators to said frame, and resilient support means including a fixed plate on the tank end face, a fixed member on the frame, and a shock absorber connected to and extending between the fixed plate on the tank and the fixed member on the frame, whereby longitudinal impact loads imparted to the heating element are resiliently absorbed by the shock absorber.

2. A heater of claim 1, wherein the shock absorber comprises opposed helically wound compression springs, a shaft extending through said compression springs and attached to the face member on the heater frame, and adjustment means for adjusting the compression of the helically wound compression springs.

3. A heater of claim 1, in combination with electrical means for selectively energizing said heating element comprising generating means mounted on the tank, and temperature sensing means within the tank for controlling the generator means.

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