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(54) **METHOD AND HOT MELT MIX APPLICATOR WITH HEATED HOSE AND APPLICATOR WAND**

VERFAHREN UND AUFTRAGEVORRICHTUNG FÜR HEISSSCHMELZGEMISCH MIT BEHEIZTEM
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METHODE ET APPLICATEUR DE MELANGE THERMOFUSIBLE COMPORTANT UN TUYAU
CHAUFFANT ET UN TUBE DISTRIBUTEUR

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Description

[0001] The present invention relates to a hot melt mix applicator for dispensing heated, flowable material of the type as described in the preamble of claim 1.

[0002] An applicator of this type is described in US-A-4,096,973. The known applicator includes a flexible hose for delivery of the flowable material from a source to the location of application. The flexible hose includes a heating element formed as a heating coil surrounding the length of the hose. As seen in the figures, the heating coil is arranged on the outer surface of the hose. This arrangement of the heating coil might prevent the heating elements to bend with a too small bending angle during movement of the hose, on the other hand, however, the heating element is subjected to wear, for instance, when the hose is laid on the floor.

[0003] Hot melt mix applicators are used to apply hot melt mix, in the form of an asphalt or bituminous hot melt material, on areas such as paved roads and the like for sealing, patching, or repairing the roads. These types of applicators are also used to apply hot melt material to hold in place raised or recessed pavement markers and to seal and protect inductive traffic loops.

[0004] In one such commercially successful hot melt mix applicator heretofore marketed by the assignee herein and disclosed in U.S. Patent No. 4,692,028, the applicator has a tank for heating and storing hot melt mix that is pumped by a pump through a hose and a wand onto pavement. During periods of operation where an operator wishes not to apply mix, but desires the mix to remain hot enough to be applied on demand, the wand is inserted into a holster connected to the tank. With the wand in the holster, the pump continuously circulates mix through the hose, wand, holster and back into the tank so that it will not harden in the wand or hose and obstruct flow.

[0005] When use of the applicator is finished, the pump is briefly reversed to clear the hose and wand of hot melt mix material before the hot melt mix is allowed to cool. Unfortunately, should hot melt mix harden within either the hose or the wand, it can partially obstruct or completely block flow through the hose causing an operator to have to clean out the hose and wand before the applicator can be used to apply hot melt mix.

[0006] To improve upon this method of preventing obstruction of the hose and wand, a single phase electrical heating system has been used to prevent hot mix material from solidifying in the hose and wand. In operation, a temperature sensor on the wand or hose communicates temperature to a controller which regulates the heat input of a heating element of the system that is in contact with the hose and wand by regulating electric power applied to the element.

[0007] In the construction of the heating element, a single heating element wire and a non-heating neutral wire make up a two-wire heating element cord that is wrapped around the hose and wand in a spiral or helical

fashion. Unfortunately, a rather dangerous electric potential of at least about 110 volts A.C. is applied to the heating element during operation to heat the hose and wand. As a result, the risk of shock is great should wires become exposed or otherwise become insufficiently insulated during operation.

[0008] Additionally, because only one wire of the pair of wires of the heating element cord wrapped around the hose can generate and transmit heat, the cord must be relatively tightly coiled around the hose and wand with a minimum of space between coils to provide the proper heat flux to prevent the hot melt mix from solidifying. Unfortunately, since only one wire of the two wire heating element cord can generate heat and since both wires of the cord bear against the hose and wand, the amount of heating element wire per unit length of cord is not maximized leading to less efficient heating element operation.

[0009] Moreover, for particularly long lengths of hose, such as hoses that are about twelve feet in length or longer, more than one temperature sensor must be used in a single phase heating system to provide adequate temperature regulation so that the hose and wand will be properly heated during operation. This additional sensor disadvantageously increases the cost and potential maintenance of the heating system while it also increases the complexity and difficulty of properly heating both the wand and hose to maintain them at a temperature which will ensure good hot melt mix flow through the hose and wand.

[0010] In the control of the heating element, the temperature controller simply regulates current flow from a single phase alternator to the heating element by turning current flow on and off. In determining whether current flow should be supplied, the controller has a selectively adjustable thermostat which communicates with the temperature sensor. If the sensed temperature is too high, the thermostat will cause the controller to turn off current flow to the heating element. If the sensed temperature is too low, the thermostat will cause the controller to turn on current flow to the heating element.

[0011] To control single phase current flow, the controller is wired in series with the heating element and simply functions as an on/off switch in response to input from a temperature sensor in communication with the hose or wand. The controller does not control operation of the alternator nor the engine. It simply functions as a switch to turn on and off current flow to the heating element.

[0012] The alternator is a conventional alternator that is connected by pulleys and a belt to a drive shaft of an internal combustion engine for supplying electrical power. The alternator has an integral power regulation circuitry to convert its raw three phase lower voltage output into single phase A.C. current having a regulated voltages of at least about 110 volts. Unfortunately, this power regulation circuitry adds to the cost of the system without adding any advantage in its use or operation.

[0013] What is needed is a more efficient and economical wand and hose heating system that more safely operates at lower voltages while still providing adequate heat to maintain hot melt mix within the hose and wand at a flowable state. What is also needed is a hot melt mix applicator of relatively compact and mobile construction that has a heated hose and wand for maximizing convenience and performance of the applicator.

[0014] This need is fulfilled by the applicator of claim 1.

[0015] The hose of the applicator of the present invention comprises a conduit having a compression-resistant flexible tubing slidably telescopically received within the conduit that limits how much the conduit can bend, preventing kinking while also resisting crushing of the conduit. A heating element is wrapped around the conduit to heat the heated flowable material within the tubing. The conduit is encased by an outer protective casing telescoped over the conduit. Between the ends of the tubing and conduit, the sliding or loose fit permits the tubing to move relative to the conduit during bending to facilitate bending of both the tubing and conduit; substantially in unison.

[0016] A heating system for a hose and wand of a hot melt mix applicator that uses a three phase electrical heating element powered by a selectively energizable generator to heat the hose and wand to maintain hot melt mix material within the hose and wand in a flowable state. To selectively energize the generator to control heat input to the hose and wand, the heating system has (1) a temperature controller in communication with a temperature sensor carried by the hose or wand and (2) a control output in communication with an input of the generator. The control input of the generator enables operation of the generator to be controlled by the temperature controller for controlling current flow to the heating element thereby controlling heating of the hose and wand.

[0017] The hot melt mix applicator has a source of hot melt mix material that preferably is contained in a kettle. The kettle preferably is of vertically upstanding, generally cylindrical construction and preferably is of double boiler construction with an envelope between inner and outer sidewalls for receiving hot oil therein to heat hot melt mix inside of the inner wall of the kettle. To enable hot melt mix material to be pumped from the kettle when heated to a flowable state, the applicator has a pump with an inlet received in the kettle and an outlet connected to the hose.

[0018] In a preferred applicator embodiment, the kettle has a hot melt mix material pump located in between a pair of agitators within the kettle for agitating hot melt mix material within the kettle during operation. Preferably, the hot melt mix material pump is a hydraulically driven pump coupled to a hydraulic fluid pump that is connected to a drive shaft of a prime mover that preferably is an internal combustion engine.

[0019] An output shaft of the engine is also coupled

to a generator of electrical power that preferably generates three phase electrical power. Preferably, the generator is a conventional vehicle alternator modified so as not to require any rectifier, voltage regulator, current regulator, or any other electrical power regulation circuitry on board the alternator for directly outputting three phase electrical power to the three phase electrical heating element.

[0020] The generator has a stator with three outputs that connect to the hose and wand heating element and a rotor that has a control input for enabling the generator to be selectively energized to control heating of the hose and wand. The control input is connected to a control output of the controller which issues a control current to turn on the rotor when the temperature of the hose or wand drops below a preset temperature.

[0021] In a preferred embodiment, the controller has its own power source that preferably is a direct current power source that preferably is a battery. To sense the temperature of the hose or wand, the controller has a pair of inputs connected by wires to the temperature sensor which is affixed to the hose or wand. Preferably the temperature sensor is an RTD thermocouple for sensing the temperature of the hose or wand. Preferably, the temperature sensor is affixed to the hose adjacent the kettle end of the hose. Preferably, the sensor is affixed to the hose about 15.24 cm from the kettle end of the hose.

[0022] To prevent hot melt mix material from solidifying within both the hose and wand, the three phase heating element is in communication with both the hose and wand. The heating element is comprised of three heating element wires, each wire for carrying a phase of the three phase electrical current from the generator. The wires of the heating element are received in insulating material which spaces each of the wires apart from each other forming a cord. The heating element cord is wrapped in a spiral or helical configuration around a wall of both the hose and the wand. At one end of the heating element cord, each of the wires of the heating element cord are connected to an output terminal of the generator. At the other end of the heating element cord, the ends of each wire are connected to each other. Each wire generates heat when current is applied, with the heating element cord having no non-heating wires or neutral wires in contact with the hose and wand where the heating element is wrapped around the hose and wand.

[0023] Preferably, each spiral or coil of the heating element cord is spaced about 1.905 cm from adjacent spirals or coils for producing a heating flux of at least about 0.3875 watts per cm² and preferably produces an optimum heating flux of about 0.5425 watts per cm² when a preferred combination of three phase voltage and current are passed through each heating element wire. Alternatively, adjacent coils of the cord can be spaced apart between about 1.27 cm to about 2.54 cm while still producing sufficient heat flux density to achieve proper

heating of the hose and wand.

[0024] Preferably, the cord is wrapped relatively tightly around the hose and wand so that it bears against the hose and wand to maximize heat transfer from each of the heating element wires to the hot melt mix material within the hose and wand.

Preferably, the cord is affixed directly to the hose and wand such as by tape that can be an insulating tape like silicone tape.

[0025] The heating element cord of the hose is connected in series with the heating element cord of the wand. To accommodate the hose being connected to the wand, the heating element cord of the hose has a non-heating portion which is connected by an electrical connector to a non-heating portion of the heating element cord of the wand, thereby connecting both cords in series. The connector allows the hose or the wand to be quickly exchanged with another hose or wand, should such a need arise. Preferably, the cord also has a non-heating portion connected by such a connector to a power cord of the applicator adjacent the kettle.

[0026] The heating element wire is constructed of a resistance-type heating wire, such as a copper wire, a copper alloy wire, nichrome, an iron-nichrome-aluminum alloy, or another type of wire capable of relatively efficiently generating heat upon the passage of current through the wire. Each of the non-heating portions of the cord is preferably constructed of copper wire having a thickness of preferably at least about fourteen gauge.

[0027] In a preferred hose construction, the hose is comprised of an inner wall formed of a strong and resilient material, such as preferably braided stainless steel hose, forming a conduit through which hot melt mix material passes during operation. The inner wall has a layer of silicone that preferably is silicone tape. Overlying this layer of silicone is the three phase heating element cord, which is wrapped in a helical spiral around the silicone layer and inner hose wall. Wrapped around the cord is another layer of silicone that preferably is silicone tape. On its exterior, the hose has a tough, durable, flexible and resilient outer rubber covering that overlies a layer of insulation that preferably can be an open or closed cell insulating foam. The temperature sensor is preferably received in a hollow in the insulation and is urged against the inner hose wall by tape wrapped around the hose. At each end of the hose is a threaded fixture for enabling the hose to be fluidtightly connected at one end to the kettle and at its other end to the wand.

[0028] The wand has a gun-type dispenser adjacent its connection with the hose. Extending outwardly from the dispenser gun is a generally rigid and generally cylindrical hollow barrel that forms a hot melt mix flow tube through which the hot melt mix material flows during operation. The heating element cord is wrapped in a spiral or helical configuration preferably around the radially outer surface of the hot melt mix flow tube to maximize heat transfer from the cord, through the tube and to the hot melt mix in the wand. Preferably, the cord is secured

against the tube by tape wrapped around the cord and tube or by another means.

[0029] To prevent a user from being burned during operation, the wand has a larger diameter outer support tube generally coaxially telescoped over the hot melt mix flow tube. To prevent heat loss and to prevent a user from being burned, insulation can be received in an envelope between the radially outer surface of the hot melt mix flow tube and the radially inner surface of the support tube. To space the tubes apart from each other, there preferably is a spacer cap on the end of the hot melt mix flow tube. To prevent the wand from dripping during operation, the nozzle at the free end of the wand preferably has a duckbill type valve.

[0030] The temperature controller has a programmable thermostat-type circuit which is in control with an external control temperature input that is selectable by the user of the hot melt mix applicator. Preferably, the external control temperature input is a knob attached to a shaft of a variable control mechanism, such as a variable resistor, variable capacitor, potentiometer, or another suitable variable control mechanism that can be analog or digital.

[0031] During operation, the temperature of the hot mix material in the hose is sensed by the controller and compared with the control temperature to determine whether to energize the generator to supply current to the heating element to heat the hose and wand. If the sensed hot melt mix temperature is above a suitable threshold above the control temperature, the controller will not energize the generator and no heat will be applied to the hose and wand. If, however, the hot melt mix temperature is less than the control temperature or below a threshold less than the control temperature, the controller energizes the generator thereby causing the heating element to heat the hose and wand. To energize the generator, the controller sends a control current from its output to the rotor input of the generator.

[0032] In a preferred embodiment of the hose and wand heating system, the controller has a lower setpoint control temperature indexed to the control temperature preset by the user that can be, for example, five degrees, ten degrees, fifteen degrees or another predetermined increment below the control temperature set. Alternatively, the lower setpoint control temperature can be the same as the control temperature set by the user. To determine when to deenergize the generator, the controller has an upper setpoint control temperature that is indexed to the control temperature and which can be a predetermined value of, for example, five degrees, ten degrees, fifteen degrees or another amount greater than the control temperature.

[0033] In another preferred controller embodiment, the controller can be constructed and arranged to control engine operation to selectively regulate the power output of the generator to control heating of the hose and wand by the heating element. The controller has an output in communication with an engine controller that

preferably can controllably vary the speed of the engine to control generator power output. Preferably, the engine controller is a solenoid coupled to the engine throttle.

[0034] In one preferred engine control regimen, the controller senses the voltage, current or power being supplied by the generator to the heating element and adjusts engine speed accordingly. In another preferred control regimen, the controller adjusts engine speed in accordance to the temperature of the hot melt mix material within the hose or wand.

[0035] In a still further control regimen, the controller energizes the generator based upon the hot melt mix temperature sensed by the temperature sensor and controls engine speed while the generator is energized. The generator is preferably selectively energized based upon the sensed temperature and/or the electrical load of the heating element.

[0036] In a novel and preferred heated hose construction, the hose comprises a woven or braided tetrafluoroethylene (TEFLON) lined conduit having a compression-resistant flexible tubing slidably telescopically received within the conduit. The conduit is attached at each end to a fitting, that preferably is a transition fitting, and is encased by the outer protective casing telescoped over the conduit that preferably comprises a rubber hose having relatively stiff reinforcing wire embedded in its sidewall that helps resist bending, crushing and twisting. The wiring preferably comprises a single helical wire within the casing sidewall that forms a crush resistant bellows-like sidewall reinforcement.

[0037] The tubing is comprised of a single continuous and elongate thin strip of metal that preferably is aluminum helically coiled with its edges engaged to form a generally cylindrical tube that can be bent, is axially compressible while also providing the conduit with increased crush resistance. To put the tubing in the conduit, the tubing is slidably telescoped into the conduit such that it is at least slightly axially compressed within the conduit to permit bending while limiting how much the conduit can be bent thereby preventing kinking. When received in the conduit, the tubing is slidably movable relative to the conduit to help accommodate bending of the conduit.

[0038] The casing extends the full length of the hose and is immovably fixed to a fitting assembly at each end of the hose by a collar that crimps the casing tightly around the fitting assembly. By this construction, the casing transmits hose tension, caused during pulling of the hose, from one hose end to the other hose end away from the conduit thereby minimizing tension transmitted to and through the more fragile conduit.

[0039] Each fitting assembly preferably comprises a swivel fitting and the transition fitting. Each collar preferably crimps the casing tightly around a housing of one of the swivel fittings. Each swivel fitting is at least partially received within the casing for insulating it. Each transition fitting is completely received within the casing

thereby insulating it. Preferably, within the hose there is an air gap between the casing and conduit that insulates the conduit.

[0040] The swivel fitting has a female threaded portion that is threaded onto a male threaded portion of the transition fitting. The other end of the swivel has a male threaded portion which can swivel relative to the housing for permitting the hose to rotate relative to that which it is attached to help prevent twisting of the hose.

[0041] The collar is elongate, cylindrical, and overlies a hole in the casing through which the heat element wiring enters the hose for preventing flexure of the casing from rupturing the casing at the bore. The collar also has a bore generally coaxial with the casing hole permitting the heat element wiring to pass through it as well.

[0042] Further advantages are provided by a hot melt mix applicator hose and wand heating system and method for controlling heat applied to a hose and wand of a hot melt mix applicator which: more efficiently heats the hose and wand using three phase electrical power; simplifies, lessens cost and increases reliability by utilizing a three phase generator that is an off-the-shelf vehicle alternator advantageously not requiring a rectifier or regulator; maximizes heat transfer and achieves more uniform heat flux by utilizing a three phase heating element that does not require a non-heating neutral or return wire; minimizes engine load and better controls heating of the hose and wand by selectively energizing the generator only electrical power is when needed; operates more safely at a lower voltage; and is a hose and wand heating system that has a minimum of components, is rugged, simple, flexible, reliable, and durable, and which is of economical manufacture and which is easy to assemble and simple to use, and a hose for transporting heated flowable material that is flexible yet offering improved kink resistance, is highly crush resistant, is twist resistant, and is a hose which minimizes tension applied to its flexible inner conduit for preventing conduit failure and the conduit pulling free of one or both of its fittings, and is a hose which is durable, rugged, simple and quick to assemble, reliable, easy to use, and which is economical to manufacture.

[0043] These and other objects, features, and advantages of this invention will become apparent from the following detailed description of the best mode, appended claims, and accompanying drawings in which:

FIG. 1 is a perspective view of a hot melt mix applicator having a hose and wand heating control system of this invention;

FIG. 2 is a side view of the applicator;

FIG. 3 is a top view of the applicator;

FIG. 4 is a partial fragmentary side view of a hose of the applicator broken away to show its three phase heating element and temperature sensor;

FIG. 4A is a cross sectional view of the hose taken along line 4A-4A of FIG. 4;

FIG. 4B is a cross sectional view of the three phase

heating element cord taken along line 4B-4B of FIG. 4;

FIG. 5 is a side view of a wand of the applicator partially broken away to show its three phase heating element;

FIG. 6 is a schematic view of the heating element and control circuit for controlling the application of current to the heating element of the hose and wand;

FIG. 7 is a partial fragmentary perspective view of an internal combustion engine of the applicator coupled to a generator for providing electrical power to the heating element;

FIG. 8 is an enlarged front view of a control box for housing a temperature controller of the heating element and control circuit;

FIG. 9 is a block diagram depicting a second control system of this invention for regulating heat input to the hose and wand by regulating engine speed thereby regulating generator output;

FIG. 10 is a fragmentary side view of a prior art hose construction cutaway to show the novel heating element wrapped interiorly around an inner conduit through which heated liquid flows;

FIG. 11 is a transverse cross sectional view of the hose taken along line 10-10 of FIG. 10;

FIG. 12 is a longitudinal cross sectional view of the hose shown in FIG. 10;

FIG. 13 is an end view of the hose shown in FIG. 10;

FIG. 14 is a perspective view of a threaded end fitting of the hose shown in FIG. 10;

FIG. 15 is a cross sectional side view of a novel heated hose construction;

FIG. 16 is cross sectional view of the hose taken along line 16-16 of FIG. 15;

FIG. 17 is a perspective view of a hose fitting of the hose shown in FIG. 15; and

FIG. 18 is a perspective view of a swivel fitting of the hose shown in FIG. 15.

I. Introduction

[0044] FIG. 1 illustrates a hot melt mix applicator 20 that utilizes a heated hose 22 and a heated wand 24 of this invention for controllably dispensing a heated flowable material 26 (in phantom) that preferably is a hot melt material or mixture such as bitumen, tar, an asphalt mixture, a resin, a thermoplastic, or another material capable of being made flowable upon heating to a desired temperature. To more efficiently heat the hose 22 and wand 24 while minimizing the risk and severity of shock to a user 28 (in phantom) of the applicator 20, three phase current of a relatively low voltage is applied to a heating element 30 (FIGS. 4 and 5) in contact with both the hose 22 and wand 24.

II. Hot Melt Mix Applicator

[0045] As is shown in FIGS. 1-3, the hot melt mix applicator 20 has a support frame 32 with a vehicle hitch assembly 34 at one end and which is supported on a pair of wheels 36 adjacent its other end. Carried by the frame 32 is a source of heated flowable material that preferably is a mixture of hot melt material received in an insulated and heated kettle 38.

[0046] The kettle 38 has a bottom wall, a generally cylindrical side wall 40, a top wall 42 and preferably is vertically upstanding in the manner shown in FIGS. 1-3. Hingedly attached to the top wall 42 is a hatch cover 44 that can be opened to put one or more solid bricks (not shown) of hot melt mix inside the kettle 38. Preferably, the kettle 38 is of double boiler construction having an interior wall spaced apart from the exterior side wall creating an envelope therebetween in which hot oil circulates during operation to heat the hot melt mix within the kettle 38 to or above a temperature at which it becomes flowable. Preferably, the kettle can be constructed and arranged substantially in accordance with the generally cylindrical sealant melting tank disclosed in U.S. Patent No. 4,159,877, the disclosure of which is hereby expressly incorporated herein.

[0047] To heat the oil and the hot melt mix material, one or more heating coils are preferably immersed in the oil. To directly heat the hot melt mix material, one or more heating coils can be located inside the interior wall of the kettle 38 in direct contact with hot melt mix inside the kettle 38. Alternatively, a gas burner (not shown) in the underside of the kettle 38 and which is coupled to a supply of gaseous fuel can be used to heat the oil to, in turn, heat the hot melt mix material.

[0048] To selectively control the temperature of the heated oil to ultimately regulate the temperature of the hot melt mix material within the kettle 38, the applicator 20 has a temperature controller 46 in communication with (1) a temperature sensor immersed in the oil to sense directly the temperature of the oil and (2) a temperature sensor in contact with hot melt mix within the kettle 38. As is shown in FIG 1, the hot melt mix temperature controller 46 preferably is constructed and arranged such that it has a display for displaying the temperature of the oil, a knob below the display for selecting the desired hot oil temperature, another display for displaying the temperature of the hot melt mix material inside the kettle 38, and a knob below it for selecting the desired hot melt mix temperature.

[0049] During initial operation, hot melt mix material within the kettle 38 is heated to a temperature of between about 176.67°C and about 204.4°C so that it will be in a flowable or even a liquified state. However, depending upon the type and nature of the material within the kettle 38 that is to be heated and applied, the hot melt mix material temperature can be greater or lower than the aforementioned range.

[0050] When the hot melt mix is heated to a temper-

ature at or above which it becomes flowable, can be pumped, or even is liquified, the hot melt mix inside the kettle 38 preferably is agitated by an agitator and pump assembly 48. Preferably, the agitator and pump assembly 48 has at least one agitator inside the kettle 38 to stir the hot melt mix to help keep it at a more uniform temperature throughout the kettle 38. Additionally, each agitator also helps to keep solids, such as fibers, granules or other particles, suspended in the mixture while it is in a heated and flowable state.

[0051] The agitator and pump assembly 48 also includes a pump (not shown) having an inlet in communication with hot melt mix inside the kettle 38 and an outlet in communication with the hose 22 for pumping heated hot melt mix material from within the kettle 38 to the hose 22 and wand 24 for being dispensed from the wand 24. The hot melt mix pump preferably is a hydraulically operated pump that preferably is of gerotor or gear-rotor construction for delivering hot melt mix material from within the kettle 38 to the hose 22 and wand 24. To control operation of the agitators and hot melt mix pump, there preferably is a control panel 49 carried by the kettle 38.

[0052] In one preferred embodiment of the hot melt mix applicator 20, the hot melt mix pump is positioned inside the kettle 38 between a pair of spaced apart agitators in the kettle 38 for enabling solids, such as fibers and the like, to remain suspended in heated hot melt mix material within the kettle 38. Preferably, the agitator and hot melt mix pump assembly 48 is constructed and arranged substantially in accordance with a pump and agitator assembly embodiment disclosed in U.S. Patent No. 4,859,073, the disclosure of which is hereby expressly incorporated herein.

[0053] To provide power to operate the hot melt mix pump, the applicator 20 has a prime mover 50 that preferably is an internal combustion engine 52, such as a diesel engine. Alternatively, the prime mover 50 can be a gasoline engine, an electric motor, a hydraulic drive, a pneumatic drive, or another type of power source. As is shown in FIG. 1, operably connected to the engine 52 is a hydraulic fluid pump 54 having an inlet line 56 and a return line 58 in communication with a hydraulic fluid tank 60. To provide fuel for operating the engine 52, the applicator 20 has a fuel tank 62 carried by its support frame 32.

[0054] During operation, the engine 52 powers the hydraulic fluid pump 54 which supplies hydraulic fluid under pressure to the hot melt mix pump to cause flowable hot melt mix material to be pumped from the kettle 38 to the hose 22 and wand 24. To cool the engine 52 during operation, the engine 52 has a radiator 64. To cool hydraulic fluid during pump operation, the engine 52 preferably also carries a hydraulic fluid radiator 66.

[0055] To control the application of hot melt mix pumped from the kettle 38 to the wand 24 and dispensed from the wand 24, the wand 24 has a gun-type dispenser 68 at one end. To selectively dispense hot melt mix from

the wand 24, the dispenser gun 68 has a trigger 70.

[0056] In a preferred embodiment of the hot melt mix applicator 20, the trigger 70 communicates directly with the hot melt mix pump to control pump operation for relatively precisely regulating the flow of hot melt mix material from the wand 24. Preferably, when the trigger 70 is depressed, it turns on the hot melt mix pump causing hot melt mix material to be dispensed from the wand 24. When released, the trigger 70 turns the pump off stopping flow to the wand 24 thereby regulating hot melt mix flow through the wand 24 and hose 22. Preferably, the control apparatus for enabling selective dispensing of hot melt mix material in this manner can be constructed and arranged substantially in accordance with the melt mix flow control apparatus disclosed in U.S. Patent No. 4,692,028, the disclosure of which is hereby expressly incorporated herein.

[0057] To minimize and preferably substantially prevent hot melt mix from dripping from the end of the wand 24, the end of the wand 24 preferably has a resilient and flexible duckbill-type valve 72 (FIGS. 1 and 5), that can be of disposable construction. In an alternative embodiment, during operation, the hot melt mix pump can continuously operate to supply hot melt mix under pressure to a wand 24 having a dispenser with a conventional valve that can be selectively opened to dispense hot melt mix material from the wand 24 and closed to stop dispensing hot melt mix material.

III. Hose and Wand Construction

A. Hose Construction

[0058] As is shown in FIGS. 1-3, the hose 22 is received in a cradle 74 carried by a pivoting swing arm 76 that is attached to the kettle 38 to enable a user 28 of the hot melt mix applicator 20 to more quickly and easily maneuver the hose 22 and wand 24 during operation. The hose 22 is of flexible and resilient construction and is connected to a fitting extending outwardly from the kettle 38 at one end and to the dispenser gun 68 of the wand 24 at its other end.

[0059] As is shown in FIGS. 4 and 4A, the hose 22 is elongate, generally cylindrical and flexible for enabling the wand 24 to be easily moved and positioned to allow a user 28 to precisely dispense hot melt mix material 26 in a desired location on the ground or pavement. At one end 104 of the hose 22 shown in FIG. 4, the hose 22 has a threaded fitting 80 for being sealingly mated to a complementary threaded fitting (not shown) of the kettle 38. At its other end 106, the hose 22 has another threaded fitting 81 for being sealingly mated to a complementary threaded fitting 110 (FIG. 5) of the wand 24.

[0060] The hose 22 has a hollow conduit 82 defined by an inner wall 84 of generally circular cross section that is preferably constructed of braided stainless steel and through which hot melt mix material can flow after it has been heated to or above its flow temperature.

Wrapped around the exterior of the interior hose wall 84 is a layer of silicone 86 that preferably is formed of a silicone tape. To maximize heat transfer from the heating element 30 to the hot melt mix material within the hose conduit 82, the heating element 30 is wrapped in a spiral or generally helical arrangement around both the silicone wrapping 86 and the inner wall 84 of the hose 22. To help electrically and otherwise insulate the heating element 30, there is another wrapping 88 of an insulating material that preferably also is silicone tape. To both thermally and electrically insulate the inner hose wall 84 and heating element 30, the second silicone wrapping 88 is preferably covered by a thicker layer of an insulating material 90 that preferably is, for example, an open or closed cell foam insulation. To provide a resilient and durable exterior, the layer of foam insulation 90 is covered by an outer layer of a flexible, resilient and durable material 92 that preferably is a rubber that is also capable of providing both electrical and thermal insulating properties. Advantageously, the construction and arrangement of the various layers which make up the hose 22 enable the hose 22 to transport hot melt mix material having a temperature of in excess of 148.9° C without a user 28 being burned or receiving an electric shock.

[0061] The hose 22 is shown in more detail in FIGS. 10-14. Resistance to the pressure of fluid flowing within the conduit 82 is provided by a cylindrical-layer 240 of braided or woven stainless steel which contacts and surrounds the conduit wall 84. The conduit wall 84 is constructed of or lined with tetrafluoroethylene (TEFLON), which comes into direct contact with the flowing hot melt mixture during applicator operation. A layer of silicone 86 surrounds and contacts the braided stainless steel layer 240. The novel heating element 30 is wrapped in a spiral around the silicone 86 and extends substantially the length of the hose 22. A layer of silicone tape 88 is wrapped around the heating element 30 to hold it in place. If desired, the foam rubber layer 90 can hold the heating element 30 against the silicone layer 86 without the use of tape.

[0062] Although only one end of the hose 22 is shown in FIGS. 10 & 12, both ends of the hose 22 are encased in a generally cylindrical metal collar 242 which fits around the protective outer rubber casing 92. The collar 242 is about 7.9375 cm in axial length and has a clamp 244 which protrudes axially outwardly from the collar 242 that clamps around the fitting 80 at the end of the hose 22. The collar 242 is continuous, cylindrical, preferably made of steel, and has no bores or holes in it.

[0063] While the casing 92 is constructed of rubber, it lacks any internal reinforcing structure that would tend to resist twisting or crushing of the casing 92. Moreover, it is not tension bearing during operation because it is not immovably fixed to any other portion of the hose 22 and is not immovably affixed to the conduit 82 nor any fitting. It simply overlies and encases the foam rubber 90 surrounding conduit 82.

[0064] The heat element wiring 30, as well as wiring leading to a temperature sensor 122 (FIG. 4), enters the hose 22 between the collar 242 and the outer rubber casing 92. Although not shown in the drawing figures, the rubber casing 92 has a slit or opening adjacent the fitting 80, covered by the collar 242, permitting the wiring 30 to be inserted further radially inwardly into the hose 22 and wrapped around the silicone 86 that encases the conduit 82. Although not shown in the drawing figures, flexibly high temperature tape preferably is wrapped around the exterior of the rubber casing 92 underneath the collar 242.

[0065] Referring to FIG. 14, the fitting 80 is a transition pipe fitting 80 having a male threaded fitting 246 at the end which extends outwardly from the hose 22 for connection to a female fitting (not shown) of the wand 24 or kettle 38. At its other end, the transition fitting 80 has an insert fitting 248 constructed and arranged to be inserted into one end of the conduit 82. Typically, the female fitting (not shown) of the wand 24 or kettle 38 is part of a swivel that is located outside the hose 22 between fitting 80 and wand 24 and fitting 81 and kettle 38 enabling the hose 22 to rotate relative to the wand 24 and/or kettle 38 during operation. Between the threaded fitting 246 and insert fitting 248 is a square or hexagonal nut 250 that can be grasped by a wrench or another tool to help thread the threaded end 246 into a female fitting (not shown) or vice versa. The fitting 80 is typically made of steel, brass, copper or aluminum.

[0066] Referring additionally to FIG. 12, the insert fitting 248 preferably is a nipple 252 having spaced apart, generally coaxial, and radially outwardly extending shoulders or barbs 254, each of which engage the interior wall 84 of the conduit 82 when inserted into the conduit 82 to resist and preferably prevent withdrawal of the fitting 248 from the conduit 82. When inserted into the conduit 82, the insert fitting 254 is sized to provide a relatively tight friction fit between it and the conduit 82 to help resist its removal. To further resist its withdrawal, a metal band, strap or ferrule (not shown) is tightened or crimped tightly around the exterior of the wall 86 of the conduit 84 to urge the wall 86 into tight engagement with the fitting 248 and its barbs 254.

[0067] Referring to FIG. 13, the clamp 244 of the collar 242 is clamped around the hex nut 250 of the fitting 80 thereby immovably securing it to the fitting 80. The nut 250 of the fitting 80 is clamped between a pair of arcuate clamp plates 256 & 258 that relatively rigidly clamp the fitting 80 to the collar 242. Although not clearly shown in FIG. 13, one clamp plate 256 is completely separable from the collar 242 and, as shown more clearly in FIG. 10, has a pair of spaced apart through-bores 243. The bores 243 are coaxial with threaded bores 245 in the other clamp plate 258. Clamp plate 258 is welded to the collar 242 to rigidly attach it to the collar 242.

[0068] With the fitting 80 received between the clamp plates 256 & 258 such that the threaded end 246 extends outwardly from the end of the collar 242, a cap

screw or bolt 260 inserted through each bore 243 in the separable clamp plate 256 is threaded into a coaxial threaded bore 245 in the collar clamp plate 258. With the bolts 260 inserted and tightened, the plates 256 & 258 clamp tightly against corners of the hex nut 250 of the fitting 80, rigidly securing the collar 242 to the fitting 80.

[0069] Referring to FIG. 12, while the collar 242 fits around the hard rubber casing 92 it does not tightly friction fit around the casing 92 and is assembled to the fitting 80 such that when the bolts 260 are removed, the collar 242 can be slipped off of the casing 92 relatively easily and with relatively little effort. The collar 242 functions only to minimize flexing of the hose 22 adjacent the fitting 80 during operation. As a result, the collar 242 does not immovably fix the casing 92 to any fitting of the hose 22 and certainly not fitting 80.

[0070] To further prevent flexing and bending of the hose 22 adjacent the fitting 80, about a one foot section of two inch diameter cylindrical marine exhaust hose 262 is relatively tightly friction fit over the collar 242 or affixed to the collar 242, as is shown in FIGS. 10-12. The marine exhaust hose section 262 is constructed of a thermoset material, typically rubber, that has a helical metal reinforcing wire 264 (FIG. 11) within its sidewall 266. The marine exhaust hose section 262 does not extend the full length of the hose 22.

[0071] While the hose construction 22 depicted in FIGS. 10-14 has enjoyed substantial commercial success, improvements nonetheless remain desirable. For example, when the hose 22 is pulled, tension is transmitted the length of the hose 22 from one fitting 80 or 81 through the conduit 82 and the braided wall 240 surrounding the conduit 82 to the other fitting 81 or 80. Because the collar 242 does not tightly urge the outer rubber casing 92 and foam rubber layer 90 against fitting 80, very little tension, if any, is transmitted through the foam rubber layer 90 and casing 92. As a result of pulling tension being transmitted only through the braided layer 240 and conduit 82, repeated pulling of the hose 22, as typically happens during operation, can cause the conduit 82 to pull completely free of fitting 80 or 81 resulting in failure of the hose 22.

[0072] Even assuming that the collar 242 could be tightly clamped or fitted around the casing 92, it still would not enable the casing 92 and/or foam rubber layer 90 to transmit a great deal of tension the length of the hose 22 because the foam rubber layer 90 is porous, highly compressible, possesses little strength in tension and extends the length of the casing 92. As a result of its porous construction, the foam rubber layer 90 would compress under the force of the collar 242 making it difficult, if not virtually impossible, for the collar 242 to tightly engage the casing 92 and immovably fix the casing 92 to any fitting 80 or 81.

[0073] Another problem with this hose construction 22 is that bending of the hose 22 anywhere between the marine exhaust hose sections 262 of both fittings 80 &

81 can cause the conduit 82 to kink undesirably reducing or even completely stopping hot melt mix flow through the conduit 82. Even worse, repeated kinking in the same area of conduit 82 can weaken the conduit 82 making it even more susceptible to repeated kinking until it cracks and fails.

[0074] A still further problem is that the hose 22 can be twisted during use which can also twist, weaken and kink the conduit 82. Repeated twisting of the conduit 82 can ultimately tear the conduit 82 causing it to fail.

[0075] A still another problem is that the outer casing 92 is constructed of a homogenous rubber sidewall only about 3.175 mm thick and lacks any reinforcing structure within the casing sidewall thereby making the hose relatively susceptible to crushing should a heavy load be applied to the hose 22, such as what can happen should a pavement roller or pavement compactor run over the hose 22. If large enough, the load can not only crush the outer casing 92, it can also crush the conduit 82 such that flow of hot melt mix through the conduit 82 is impeded or completely obstructed resulting in failure.

[0076] Unfortunately, failure of the hose 22 typically requires its replacement because it is no longer suitable for transporting hot melt mix. Where the failed hose 22 is relatively new, replacement is done under warranty undesirably significantly increasing warranty costs. Even when a failed hose 22 can be repaired, it still is costly because hose repair is a labor intensive process.

[0077] FIGS. 15-18 illustrate a novel hose construction 22' of this invention for transporting heated flowable materials, such as preferably a hot melt mix material that consists of, at least in part, petroleum-based material or materials, including without limitation heated flowable tar, bitumen, asphalt or another suitable flowable material that is heated to make it flow and applied while hot on an object as part of a processing operation or a repair operation. While the hose construction of this invention can be used to apply conventional hot melt mix, it can also be used to apply hot glue, hot polymer, hot elastomeric material, hot thermoplastic material and hot thermosettable material which becomes flowable when heated and which must be heated to a fluid-like state before being applied to an object as part of a processing or repair operation. While the hose 22' of this invention is well suited for transporting heated flowable mixtures, it is also well suited for transporting a heated flowable material that is composed of only a single component, a single material, a single chemical, a single chemical compound or another heatable flowable material which is not a mixture of materials.

[0078] As is depicted in FIGS. 15-18, the novel hose 22' has an elongate inner flexible reinforcing tubing 270 through which the heated flowable material flows that is constructed and arranged to be flexible, so the hose 22' can bend during use, while limiting the bending of fluid-tight conduit 82 to a radius of curvature of no smaller than about 25.4 mm for preventing kinks from forming in the conduit 82 and tubing 270. Preferably, the flexible

tubing 270 is constructed such that it cannot be bent over itself such that one portion of the tubing 270 is folded over on another portion of the tubing 270 at the point where the tubing 270 is bent for preventing kinking.

[0079] As is shown in FIG. 15, the flexible reinforcing tubing 270 preferably is helical interlocked flexible aluminum conduit of conventional construction that can also be made of steel, copper or another material impervious to the heated flowable material flowing through it during operation. Preferably, the tubing 270 is constructed of aluminum so it is strong, crush resistant, corrosion resistant, kink resistant, yet light in weight.

[0080] The tubing 270 preferably is formed of a single continuous elongate strip 272 of relatively thin but generally rigid material having a flange 274 extending outwardly in one direction along one edge of the strip 272 and another flange 276 extending outwardly in an opposite direction along the other edge which interlock when the strip 276 is helically coiled and flange 274 engaged with an adjacent flange 276 of an adjacent portion of the strip 272 to form a generally cylindrical tube 270 that is flexible and axially compressible while providing excellent crush resistance. To limit axial compression of the tubing 270 while further increasing its crush resistance, the strip 272 has a generally U-shaped radially outwardly extending ridge 278 between the flanges 274 & 276 and a flat portion 280 alongside the ridge 278. The width of the flat 280, along with the interlocking flange construction of the tubing 270, helps control the amount that the tube 270 can bend while also limiting how much it can be axially compressed and expanded.

[0081] Preferably, the aluminum flexible tubing 270 has an outer diameter of between about 12.573 and about 12.446 mm so as to allow hot melt mix to flow relatively unimpeded through it. Preferably, the tubing 270 has a ridge height of between about 1.5875 mm and about 0.79375 mm and a wall thickness of approximately one millimeter. The tubing 270 is received within conduit 82 and can move axially relative to conduit 82 during operation. Although each end of the tubing 270 can be fixed adjacent each end of conduit 82 by being friction fit, captured between conduit 82 and fitting 80, or attached in another manner such that each tubing end does not move relative to the conduit 82 at or adjacent its end, it preferably is not fixed at each end.

[0082] During assembly, because the tubing 270 is axially compressible, a length of tubing longer than the axial length of the conduit 82 is slidably telescopically inserted into the conduit 82 such that it floats within the conduit 82. For example, where the desired length of hose 22' (and conduit 82) is 4.2672 or 4.572 meters, as much as 6.7956 of tubing 270 is stuffed into the conduit 82. Where the conduit 82 is 3.048 meters long, approximately 4.1148 meters of tubing 270 is stuffed into the conduit 82. By axially compressing the tubing 270, it helps prevent kinking by limiting the radius of curvature of any bend of the tubing 270.

[0083] Conduit 82 is preferably constructed of or lined

with tetrafluorethylene (TEFLON) or another suitable polymeric material, but can be constructed of another flexible and resilient synthetic, plastic or elastomeric material such as nylon, polyurethane, polyethylene, a plastic or another material that is relatively impervious to the heated flowable material flowing through flexible tubing 270. Preferably, conduit 82 is impervious to petroleum products, tar, bitumen and asphalt. TEFLON is the preferred material of construction of conduit 82 because it is flexible, is relatively impervious to commercially available hot melt mixes, offers relatively low resistance to fluid flow, and is resistant to temperatures above 350° Fahrenheit, making it particularly well suited for conducting flowable hot melt mix having at similar high temperatures. In one exemplary preferred embodiment, conduit 82 has an inner diameter of about 19.05 mm so as to receive tubing 270 such that there is a sliding or loose fit therebetween and has a wall thickness of slightly greater than about 0.79375 mm. Between the ends of the tubing 270 and conduit 82, the sliding or loose fit permits the tubing 270 to move relative to the conduit 82 during bending to facilitate bending of both the tubing 270 and conduit 82 substantially in unison.

[0084] Preferably, the conduit 82 has an outer sheath or sleeve 282 comprising of a woven or braided material that is constructed and arranged to improve the pressure resistance of conduit 82 to fluid or flowable material flowing through the tube 270 and/or conduit 82. Although the sleeve 282 can be constructed of steel or an alloy thereof, such as a woven or braided stainless steel, it preferably is constructed of woven or braided nylon or another suitable synthetic material resistant to high temperature while also being burst resistant. By this construction, sleeve 282 imparts increased burst resistance to conduit 82.

[0085] Where the hose 22' is designed to be heated during operation, heating element wires 30 are preferably wrapped directly around sleeve 282. To hold the wiring 30 against the sleeve 282, there is a constraining layer 284 over the wiring 30 that preferably comprises silicone tape 284. If desired, however, the heat element wires 30 can be wrapped around a layer of silicone or similar material that encases the sleeve 282. While the hose 22' of this invention is well suited for use with the novel three phase heating element system disclosed herein, it also can be used with a single phase heating element or another type of hose heater.

[0086] Referring now to the ends of the hose 22', a representative end 286 of the hose 22' is shown in FIG. 15. The hose end 286 shown in FIG. 15 is substantially the same as its opposite end (not shown) except that the opposite hose end can be constructed without heat element wiring 30 entering or exiting the hose 22'. As is depicted in FIG. 15, recessed within each end of the hose 22' is a fitting assembly 287 comprising a transition fitting 80 and a swivel fitting 288.

[0087] As is shown in FIG. 17, fitting 80' is substantially the same as fitting 80 depicted in FIG. 14. Prefer-

ably, it is virtually identical and hence will not be described further herein. Fitting 80' is further axially recessed within the hose 22' than it is in hose 22 to accommodate a swivel fitting 288 within the hose 22'. By recessing the swivel 288, it helps insulate the swivel 288 thereby lessening heat loss from hot mix material flowing through the swivel 288. By lessening heat loss, less energy is required to maintain the temperature of the hot melt mix flowing through the hose 22' thereby also helping to maximize the rate of flow of hot melt mix material through the hose 22'.

[0088] Referring once again to FIG. 15, fitting 80' has its barbed end 248' fluidtightly received in the end of conduit 82 with the axially outer end of the barbed end 248' preferably adjacent or abutting an end of the flexible tubing 270. To help keep the conduit 82 on the fitting 80', there is a metal ferrule 290 clamped or crimped around the conduit 82 urging the conduit 82 into tight intimate contact with a portion of the fitting end 248'.

[0089] Referring additionally to FIG. 18, the swivel 288 is constructed to permit the hose 22' to rotate at each end relative to either the wand 24 or kettle 38 or a fitting of the wand 24 or kettle 38. By permitting the hose 22' to rotate, twisting of the hose 22' is minimized, further helping to prevent conduit 82, as well as tubing 270, from kinking and tearing.

[0090] The swivel 288 has an outer housing 292 with a female threaded fitting 294 at one end that threads on the male threaded end 246' of fitting 80'. Extending outwardly from inside the swivel housing 292 is an exteriorly threaded male fitting 296, constructed and arranged to rotate relative to the housing 292, that preferably threads into a female fitting of either the wand 24 or kettle 38. The male swivel fitting 296 has a square or hexagonal nut 298 located adjacent the housing 292 which is located outside the hose 22' so it can be engaged by a wrench or another tool to rotate it to thread it into or unthread it from the female fitting of the wand 24 or kettle 38.

[0091] To provide a fluid tight seal between a portion 300 of the threaded swivel fitting 296 received inside the swivel housing 292 and the housing 292, the fitting 296 has a grease or dust seal 302 between it and the housing 292 that preferably comprises an O-ring 302 constructed of BUNA-N or a similarly suitable seal material. To facilitate rotation of the fitting 296 relative to the housing 292, there are a plurality of circumferentially spaced apart ball bearings 304 between the fitting 296 and housing 292 which are preferably constructed of chromium or another suitable bearing material. To further provide a seal, the swivel 288 has a pair of axially spaced apart O-rings 306 preferably constructed of HYTREL or the like that sandwich another O-ring 308 constructed of a suitable seal material that preferably is AFLAS or VITON.

[0092] To prevent the fitting 296 from separating from the housing 292 while permitting it to rotate relative to the housing 292, the housing 292 can be and preferably

is constructed with a radially inwardly extending set screw or bolt (not shown) that is seated in a complementary groove (not shown) in the outer surface of the inner fitting portion 300 which extends about the circumference of the fitting portion 300. Preferably, both the housing 292 and threaded fitting 296 of the swivel 286 are constructed of steel that is zinc plated such that it is suitable for hydraulic oil applications making it well suited for hot melt mix materials.

[0093] To transfer tension during pulling of the hose 22' away from the inner conduit 82, the hose 22' has a hollow and generally cylindrical outer protective casing 310 that extends from one end of the hose 22' to the opposite end of the hose 22' and which is immovably fixed at each end of the hose 22' to the fitting assembly 287 by being secured to either the swivel housing 292 or the nut 250' of fitting 80', or both.

[0094] Preferably, the casing 310 is constructed of a durable, resilient and at least somewhat flexible material that preferably is resistant to relatively high temperatures in excess of about 148.9°C. Preferably, the casing 310 comprises a single continuous generally cylindrical sidewall 312 composed of a thermoset material that is durable such that it can withstand scraping along pavement as well as being resistant to abrasions, cuts and nicks which can occur during use. Preferably, the casing 310 is constructed and arranged such that it limits bending of the conduit 82 by itself not being able to be bent no less than about a 38.1 mm radius of curvature.

[0095] Preferably, the casing sidewall 312 is composed of a rubber, such as PVC rubber (a mixture of acrylonitrile-butadiene rubber and polyvinylchloride) or the like and can be laminated with a relatively thin sheet of helically woven fabric about its outer surface. If greater temperature resistance is desired, the casing sidewall can be constructed of neoprene rubber. A casing 310 of this construction is relatively stiff yet flexible to allow the hose 22' to bend a limited amount while preventing the radius of curvature of the hose bend from becoming too small to prevent kinking of conduit 82.

[0096] To resist extreme bending and crushing of the casing 310, the casing 310 preferably is reinforced with a continuous and generally helical wire 314 embedded within the casing sidewall 312. Preferably, the wire 314 is constructed of spring steel, stainless steel, or another stiff material to help the casing 310 resist bending and crushing of the casing 310 thereby protecting the conduit 82 and tubing 270 from being crushed.

[0097] As is shown in FIG. 15, the casing 310 encompasses both fitting 80' and swivel fitting 288 helping to insulate them. Preferably, the inner diameter of the casing 310 is larger than the outer-diameter of the conduit 82, even with the heating element-30-wrapped around it, so that there is an insulating annular air gap 316 between the exterior of the silicone tape 284 and the interior of the casing 310. If desired, an insulating foam or another insulating material can be provided in the gap 316.

[0098] In the exemplary preferred embodiment, the casing 310 is a bellowsflex type hose having an inner diameter of about 31.75 mm and a wall 312 having a thickness of about 4.7625 mm with an embedded integral helical or spiral reinforcing wire 314 having adjacent loops of the wire 314 axially spaced apart a little more than about 9.652 mm. For example, a suitable casing 310 can be a hose constructed in accordance with SAE standard J 1527 and which also complies with U.S. Coast Guard Type B-2 marine hose requirements. Preferably, the casing 310 is a marine fuel or exhaust hose having the aforementioned dimensions and complying with the above mentioned standards and/or ratings. Preferably, the casing 310 is a bellowsflex-type marine fuel or exhaust hose. If desired, the casing 310' can also comprise a conventional steel helix reinforced rubber gasoline hose or a bellows flex-type rubber gasoline hose of similar construction.

[0099] Advantageously, a casing 310 of this construction is fluidtight, tough, durable, resilient, flexible, kink resistant, crush resistant, relatively impervious to most chemicals, and twist resistant to preventing kinking and tearing of the conduit 82 within while also transmitting hose tension away from conduit 82 helping to prevent conduit 82 from pulling free of fitting 248'.

[0100] The protective outer casing 310 is immovably fixed at each end to the swivel housing 292. While the casing 310 can be adhesively affixed to the swivel housing 292 or secured to the housing 292 using one or more fasteners (not shown), the casing 310 preferably is fluidtightly fixed to the housing 292 by an outer metal collar 318 that urges the casing 310 against housing 292. Preferably, the collar 318 is crimped around the casing 310 and housing 292 adjacent the swivel fitting 296 urging the casing 310 into tight intimate contact with the swivel housing 292. By this tightly crimped construction, none of fittings 80' & 288 will pull free of the casing 310 during operation resulting in pulling forces (hose tension) being transmitted primarily along the casing 310 to the fitting 288 and vice versa thereby minimizing the amount of force transmitted to and through conduit 82.

[0101] If desired, one end of the collar 318 can be crimped downwardly such that it forms a lip 320 around the end of the casing 310. If desired, the lip 320 can extend radially inwardly beyond the axial end of the swivel housing 292 such that it interferes with the end of the housing 292 to oppose withdrawal of the housing 292 from the casing 310.

[0102] The collar 318 preferably is constructed of a metal that preferably is steel. However, if desired, the collar 318 can be constructed of copper, brass, aluminum or another suitable metal or non-metallic material. For example, the collar 318 can be constructed of a heat shrinkable material that is tightly heat shrunk around the casing 310 and swivel housing 292.

[0103] To permit the heat element and temperature sensor wiring to be introduced around the inner conduit 82, the casing 310 has a hole 320 in it through which

the wiring extends. To prevent flexing of the casing 310 from tearing the casing 310 at or about the hole 320, the collar 318 axially extends beyond and around the hole 320, as is shown in FIG. 15, to limit the amount of movement and flexing the casing 310 can undergo near the hole 320, in effect providing strain relief to the casing 310. To accommodate the wiring 30, the collar 318 itself has a through bore 322 through which the wiring 30 also passes.

[0104] In assembly, the conduit 82 is cut to size and the fitting 80' is inserted into the conduit 82. Thereafter, the flexible tubing 270 is inserted into conduit 82 preferably until its axial end abuts or is adjacent the end of the insert fitting 248' of fitting 80'. Thereafter, fitting 81 is attached to the other end of the conduit 82 capturing the tubing 270 within. The swivel fitting 288 is attached to the threaded end 246' of fitting 80' and the conduit 82 is inserted into casing 310. Before the conduit 82 is inserted into the casing 310, it is wrapped with heating element wiring 30. Each end of the casing 310 is fixed to the swivel housing 292 by the collar 318 resulting in a high temperature hose 22' that is ready to be used.

[0105] After the hose 22' is assembled, it is attached at one end preferably to a generally stationary object, such as the kettle 38, and at its other end to an object that can be and typically is maneuvered during operation, such as the wand 24. If desired, two or more hoses 22' can be coupled to make a longer length of hose.

[0106] In operation, heated flowable hot melt mix material flows through the interior of the flexible tubing 270 from one end of the hose 22' to the other end of the hose 22'. As the hose 22' is twisted, one or both swivels 288 at each end of the hose 22' permit the hose 22' to rotate relative to either or both the wand 24 and/or kettle 38 thereby preventing the hose 22' itself from twisting too much thereby preventing kinking and collapse of conduit 82. The casing 310 also inherently resists twisting of the hose 22' and conduit 82.

[0107] As the hose 22' is bent, the casing 310 increasingly resists bending for helping to prevent the hose 22' from reaching such a small radius of curvature that the conduit 82 kinks. In addition to the casing 310 resisting bending, the flexible tubing 270 within the conduit 82 further resists bending in this same manner.

[0108] As the hose 22' is externally compressed radially inwardly by an external crushing force, the wire reinforced construction of the casing 310 resists crushing of the casing 310 thereby also protecting the conduit 82 and tubing 270 within. Should the casing 310 be crushed such that it contacts the conduit 82, the tubing 270 provides further crush resistance to the conduit 82.

[0109] As the hose 22' is pulled, most, if not virtually all of the hose tension, and hence strain, is transmitted from one end of the hose 22' along the casing 310 to the other end of the hose 22' by virtue of the casing 310 being rigidly fixed to swivel housings 292 at both ends and the swivel housings 292 being rigidly connected to the kettle 38 and wand 24. Preferably, tension actually

applied to the conduit 82 during stretching of the hose 22' is advantageously minimized by this novel hose construction because most, if not virtually all, of the tension is transferred around the conduit 82 to end fittings 288 thereby preventing any end of the conduit 82 from ever being pulled free of fitting 82.

3. Novel Heating Element

[0110] To prevent hot melt mix inside the hose 22 from solidifying in the hose 22 during operation, coaxially wrapped in a spiral or helical arrangement around the inner wall 84 of the hose 22 is the heating element 30. The heating element 30 is comprised of a cord 94 having three wires 96, each of which carries current during operation to generate heat to heat the hot melt mix material within the hose conduit 82.

[0111] The three wire heating element 30 is a three phase heating element for carrying three phase current to more efficiently heat the hot melt mix within the hose 22. As is shown in FIGS. 4 and 4B, the heating element cord 94 has a first wire 98 for carrying one phase of the three phase heating current, a second wire 100 for carrying another phase of the three phase heating current, and a third wire 102 for carrying a further phase of the three phase heating current.

[0112] As is shown in FIG. 4B, to prevent electricity from passing between the wires 98, 100 and 102 during operation, the exterior cord material is constructed of an electrically insulating material 132 that preferably also spaces each wire apart from the other wires to further prevent short circuiting. The cord 94 preferably is of generally elongate and oblong cross section having a top surface 134, a bottom surface 136 and a pair of sides 138 constructed and arranged such that its width is at least slightly larger than its thickness. To maximize heat transfer from the wires 98, 100 and 102 to the hose 22 and hot melt mix material flowing through the hose 22, the cord 94 is wrapped around the hose 22 such that one of its elongate surfaces, 134 or 136, are in contact with the hose 22. Preferably, the cord 94 is wrapped around the hose 22 such that its generally flat bottom surface 136 is in contact with the silicone layer 86 overlying the inner hose wall 84 and bears against the inner hose wall 84. In this manner, heat generated by all three wires 98, 100 and 102 is efficiently transmitted through the silicone 86, inner hose wall 84 and to the hot melt mix material flowing through the hose 22 to help keep the material in a flowable state.

[0113] To provide the desired heat flux along the length of the hose 22 to prevent solidification, the distance, *a*, between adjacent loops or coils of the cord 94 is about 19.05 mm. Alternatively, the cord 94 can be wrapped about the hose 22 such that the distance between adjacent loops or coils, *a*, is between about 12.7 mm and about 25.4 mm. In a preferred embodiment, the heating element cord 94, the wires 98, 100 and 102, the spacing, *a*, between adjacent loops of the cord 94, and

the three phase current applied to the cord 94 are selected to provide a heat flux of about 0.5425 watts per cm².

[0114] Each wire 98, 100 and 102 of the cord 94 is constructed of an electrically conductive material that has sufficient resistance to electrical current flow such that it generates heat upon the passage of current through the heating element wire. Preferably, each wire 98, 100 and 102 is constructed of a resistive copper material, nichrome, an iron-nichrome-aluminum alloy, or another electrically resistive, electrically conductive material that produces heat upon the application of electrical current. Preferably, each wire 98, 100 and 102 is constructed of TEFLON coated copper and can have a wire diameter of about eighteen gauge.

[0115] Advantageously, the construction and arrangement of the heating element 30 is such that each wire 98, 100 and 102 of the heating element cord 94 wrapped around the hose 22 generates heat when three phase current is applied to the heating element 30. Advantageously, no neutral or return wire is required, so all of the wires 98, 100 and 100 of the heating element 30 generate heat to more efficiently heat the hot melt mix material inside the hose 22 and wand 24. As a result, the surface area of heat generation is maximized per unit length of heating element cord 94 as compared to a single phase heating element cord.

[0116] At the kettle end 106 of the hose 22, the input end 112 of the heating element cord 94 is preferably in electrical communication with a three phase electrical power source 114 (FIG. 1) for receiving three phase electrical power from the power source 114. Referring additionally to FIG. 5, at the wand end 108 of the hose 22, preferably the cord 94 is attached by a connector 116 to the heating element 30 of the wand 24. Since heating is not necessary where the cord 94 is exposed between the wand 24 and hose 22, the cord 94 preferably has a non-heating portion 118 between the wand 24 and hose 22 that preferably is constructed of a larger diameter copper wire that can be of fourteen gauge or thicker copper wire.

[0117] Alternatively, the heating element cord 94 can be constructed and arranged to terminate at or adjacent the wand end 108 of the hose 22, such as at reference numeral 120 (FIG. 4), if it is only necessary to heat the hose 22 and not the wand 24 during operation. If the heating element cord 94 terminates at the wand end 108, each of the three wires 98, 100, and 102 are connected together, preferably at reference numeral 120, to form a complete three phase heating element circuit.

[0118] To enable sensing of the temperature of the hot melt mix material within the hose 22, the hose 22 preferably also has a temperature sensor 122. As is shown in FIG. 4, the temperature sensor 122 is received in a hollow in the foam insulating layer 90 and is secured to the hose 22 by at least one layer of a tape 124 that preferably is silicone tape. Preferably, the sensor 122 is affixed to the hose 22 such that it bears against the inner

hose wall 84 for being able to more accurately sense the temperature of the hose 22 and hot melt mix material in the hose 22 in the region of the sensor 122.

[0119] Preferably, the temperature sensor 122 is an RT-type thermocouple 126 for providing an electrical current representative of the temperature of the hot melt mix material inside the hose 22. To communicate current from the sensor 122 to a device, such as preferably the controller 128 (FIGS. 1, 6 and 8), the sensor 122 has a pair of wires 130 extending from it. Preferably, the sensor 122 is disposed at least about six inches from the axial end of the fixture 80 at the kettle end 106 of the hose 22 for facilitating accurate temperature measurement. Alternatively, the sensor 122 can be a thermistor or another type of sensor capable of sensing the temperature of hot melt mix inside the hose 22.

[0120] Alternatively, if desired, the temperature sensor 122 can be affixed to the wand 24 for measuring the hot melt mix material temperature at a point remote from the kettle 38. Alternatively, a pair of sensors (not shown) can be used with, for example, one of the sensors in communication with the hose 22 and the other of the sensors in communication with the wand 24. However, the preferred embodiment of this invention requires only a single sensor 122 carried by the hose 22 capable of sensing or representing the temperature of the hot melt mix material within the hose 22 and adjacent the sensor 122.

[0121] Advantageously, as a result of the construction and arrangement of the three phase heating element 30, construction of the hose 22 and the use of three phase electrical current to heat the hot melt mix, only one temperature sensor 122 is needed. Alternatively, more than one temperature sensor can be used, if desired, to provide the temperature of hot melt mix at different locations along the hose 22. Alternatively, more than one temperature sensor can be used, if desired, to provide the temperature of hot melt mix material in the wand 24 or at different locations along the wand 24.

B. Wand Construction

[0122] The wand 24 has a dispenser gun 68 with a generally cylindrical and elongate hollow barrel 140 extending outwardly from the gun 68 for enabling hot melt mix material to be dispensed from the wand 24 conveniently onto the ground without an operator 28 having to uncomfortably bend down or stoop during operation. The barrel 140 of the wand 24 is preferably constructed of a rigid, generally cylindrical and elongate pipe or tube 142 that can be constructed of a metal, such as a stainless steel; a plastic, such as a thermoset; a composite, such as a glass filled nylon; a ceramic; a combination thereof, or another suitable material. The tube 142 is hollow for permitting passage of hot melt mix material through the tube 142. The tube 142 is preferably threadably received in a complementary threaded female fitting of the dispenser gun 68.

[0123] Generally coaxially overlying the hot melt mix flow tube 142 is an outer covering 144 that preferably also is generally tubular and elongate. The outer covering 144 is spaced sufficiently radially outwardly away from the hot melt mix flow tube 142 such that it insulates a user 28 of the wand 24 from the heat of the hot melt mix flowing through the tube 142. Preferably, the covering 144 is a support tube 146 that is attached to the dispenser gun 68 at one end and a dispenser cap 148 at the other end. To help manipulate the rather long wand 24 during operation, a user 28 can grasp a handle 152 attached to the support tube 146 at a location disposed downstream from the dispenser gun 68.

[0124] The duckbill valve 72 is carried by the cap 148 at the nozzle 151 at the free end 150 of the wand 24. The cap 148 is also attached to the free end of the hot melt mix tube 142 and has an outer diameter larger than the outer diameter of the hot melt mix tube 142 for radially outwardly and coaxially spacing the support tube 146 from the hot melt mix tube 142. If desired, an envelope 154 between the hot melt mix flow tube 142 and the support tube 146 can contain an insulation, such as an open or closed cell foam.

[0125] As is shown in FIG. 5, the hot melt mix applicator wand 24 also has a heating element 30 that preferably extends to adjacent the free end 150 of the wand 24 for providing heat to hot melt mix material in the flow tube 142 of the wand 24. To complete the three phase electrical heating circuit, the wires 98, 100 and 102 of the heating element cord 94 are electrically connected together preferably in or adjacent the end cap 148.

[0126] As is shown in FIG. 5, a preferably non-heating portion 118 of the heating element cord 94 of the hose 22 emerges from a collar 158 adjacent the end 108 of the hose 22 and connects to another preferably non-heating element portion 118 of the heating element cord 94 of the wand 24. Where hot melt mix material leaving the hose 22 enters the dispenser gun 68, it is preferably redirected through a generally perpendicular elbow 156 in the gun 68 into the flow tube 142. To prevent solidification of hot melt mix material in the region of the elbow 156, at least a portion of the heating element cord 94 preferably contacts directly against the elbow 156. If desired, one or more loops of cord 94 can be wrapped around the elbow 156. If desired, the elbow 156 and heating element cord 94 can be constructed and arranged such that a portion of the cord 94 is immersed directly in the hot melt mix material.

[0127] Preferably, the construction, arrangement and spacing, a, of the three phase heating element cord 94 wrapped helically about the exterior of the hot melt mix flow tube 142 of the wand 24 is substantially the same as the heating element cord 94 wrapped about the hose 22 previously described herein and hence will not be further described.

IV. Three Phase Heating Element System, Circuit and Control

[0128] FIG. 6 illustrates a three phase heating system 160 for controllably supplying heat preferably to both the hose 22 and wand 24 to heat and maintain hot melt mix material in both the hose 22 and wand 24 at a temperature at which the material can flow. The three phase heating system 160 is comprised of an electrical circuit 160 that includes the three phase power source 114 coupled to the three phase heating element cord 94 of the hose 22 and wand 24, with the operation of the power source 114 and heating element 30 controlled by the temperature controller 128. As is shown in FIG. 6, the heating element cord 94 of the hose 22 is connected in series to the heating element cord 94 of the wand 24.

A. Three Phase Power Source

[0129] Preferably, the three phase power source 114 is a delta three phase power source 162, as is shown in FIG. 6. Alternatively, for example, the power source 162 can be a wye three phase power source (not shown). To selectively control application of power to the heating element 30, the three phase power source 162 has a control input 164 in communication with a control output 165 of the temperature controller 128 that enables the controller 128 to selectively control operation of the heating element 30 by directly controlling operation of the power source 114.

[0130] As is shown in FIG. 6, the power source 114 preferably comprises a three phase generator 166 having a stator 168 in electrical communication with the heating element 30 and a rotor 170 connected to the control input 164. The generator control input 164 is connected to the temperature controller control output 165 for enabling the operation of the generator 166 to be directly controlled. The stator 168 is constructed and arranged in a delta configuration 162 having an output terminal 172 connected to heating element wire 98 of the heating element cord 94, another output terminal 174 connected to heating element wire 100, and a still further output terminal 176 connected to heating element wire 102.

[0131] The rotor 170 has a winding 178 in magnetic field communication with a winding 180 of the stator 168 with one leg of the winding 178 connected to a ground 182 and another leg of the winding 178 connected to the temperature controller output 165. To prevent reverse flow of current around the rotor winding 178, there is a diode 184 connected in parallel with the winding 178 to the control input 164.

[0132] In the control of the operation of the generator 166, the stator 168 is energized upon application of current from the temperature controller output 165 to the rotor input 164, thereby causing the generator 166 to generate and supply three phase electrical power to the three phase heating element 30 of the hose 22 and

wand 24. When no control current is applied to the rotor 170 by the temperature controller 128, no electrical power is generated by the generator 166. Therefore, when the temperature controller 128 desires to stop the heating element 30 from supplying heat to the hose 22 and wand 24, the controller 128 simply ceases supplying control current to the rotor 170. In this manner, the amount of heat applied to the hose 22 and wand 24 can be advantageously controllably regulated in a relatively precise fashion.

[0133] When control current from the temperature controller 128 is applied to the rotor 170, the current causes the rotor winding 178 to generate a magnetic field which communicates with the stator winding 180 thereby causing electrical power to be generated. In this manner, control current energizes the stator 168 causing it to produce electrical current. When no control current is applied, no magnetic field is created, and no power is generated.

[0134] Referring additionally to FIG. 7, the generator 166 has a pulley 186 on its input shaft coupled to a pulley 188 on a drive shaft of the engine 52 by an endless flexible belt 190. The generator 166 is carried by a bracket 192 affixed to the support frame 32 and has three outputs 172, 174 and 176, one for each phase of the power delivered to the heating element wires 98, 100 and 102.

[0135] Preferably, the generator 166 is a modified vehicle alternator 194 coupled to the engine 52 in the manner shown in FIG. 7. Preferably, the alternator 194 is modified so that it produces three phase current across its output terminals 172, 174 and 176. Preferably, the alternator 194 is a conventional vehicle alternator modified such that its rectifier and voltage regulator circuitry are not required, with electrical power being delivered directly from the alternator 194 to the heating element cord wires 98, 100 and 102 without needing to be regulated by any voltage or current regulator.

[0136] The alternator 194 preferably can be a modified claw-pole type alternator, although the alternator can be of compact alternator construction, can be a salient pole alternator, can be an alternator having a windless rotor, or can be another type of generator capable of generating three phase electrical power. Preferably, the alternator 194 is a Southwest Products Model No. 333 alternator to produce three phase current. Such an alternator 194 preferably produces no greater than about sixty volts and at least about twenty volts and several amperes of electrical power during operation to cause the heating element 30 to generate a desired amount of heat to achieve and maintain the flowability of hot melt mix material within the hose 22 and wand 24. In a preferred embodiment, the alternator 194 preferably produces about thirty six volts at generally optimum operating conditions. Of course, loading on the engine by the hydraulic pump and other engine loads can cause some fluctuations in output voltage. Alternatively, the output voltage and amperage of the alternator 194 can be more or less dependent upon the construction of the

alternator 194, the output speed of the engine 52, the load on the alternator 194 produced by the heating element 30, as well as other factors.

B. Temperature Controller

[0137] The temperature controller 128 is shown in block form in FIG. 6 with numbered pinouts depicting the various input and output connections of the controller 128. During operation, the temperature controller 128 communicates with the temperature sensor 122 affixed to the hose 22 and energizes or deenergizes the generator 166 in response to the hose/hot melt mix temperature sensed by the sensor 122. If the hot melt mix temperature is high enough, indicating that hot melt mix material within the hose 22 is at a temperature at which it will suitably flow, the generator 166 is not energized or is deenergized thereby causing the generator 166 to supply no electrical power to the heating element 30. Should the hot melt mix temperature drop below a predetermined value indicating that hot melt mix material within the hose 22 (1) is not at a temperature at which it will easily flow, or (2) is approaching a temperature below which it will not easily flow, the temperature controller 128 preferably energizes the generator 166 to cause electrical power to be supplied to the heating element 30 so that the hose 22 and wand 24 will be suitably heated to help ensure flowability of the hot melt mix material.

[0138] To supply power to the controller 128, the controller 128 is connected to a power source 196 that preferably is a direct current power source, such as a battery of conventional construction or the like. As is shown in FIG. 6, a positive terminal 198 of the battery is connected to pins 3 and 6 of the temperature controller 128 for supplying electrical power to the controller 128. A negative terminal 200 of the battery 196 is connected to a ground 202 that preferably can be in electrical communication with the rotor ground 182. In addition to being connected to the ground 202, the negative terminal 200 of the battery 196 is also connected to pin 5 of the temperature controller 128.

[0139] One wire 130 of the temperature sensor 122 is connected to pin 1 of the temperature controller 128 and the other wire 130 of the sensor 122 is connected to pin 2 of the controller 128 for enabling the controller 128 to communicate with the sensor 122. To control operation of the generator 166 based upon the sensed hot melt mix temperature, pin 7 of the controller 128 is the output 165 that is connected to the control input 164 of the generator 166. Preferably, pins 1 and 2 of the controller 128 extend from an integral thermostat circuit 230 (FIG. 6A) of the controller 128 which has a switching mechanism 232 (FIG. 6A), such as a conventional switch, a solid state switch, a relay or the like, for enabling a control current to be selectively delivered the rotor input 164 when the hot melt mix hose temperature is too low. Preferably, the switching mechanism 232 of the controller

thermostat circuit 230 delivers control current directly or indirectly from the battery 196 to the controller output 165 which communicates the control current to the control input 164 of the generator 166.

[0140] Referring additionally to FIG. 8, the temperature controller 128, including its accompanying internal circuitry, is received in a control box 204 that is affixed to the exterior of the kettle 38. If desired, the battery 196 can also be received within the control box 204. To activate the controller 128, the box 204 has an "on/off" switch 214 and an indicator light 216 on top of the box 204. Preferably, the indicator light 216 is lit when the switch 214 is switched to its "on" position.

[0141] As is shown in FIG. 8, mounted on the face of the control box 204 is an indicator label 206 indicating a plurality of control temperature settings that the controller 128 can be set at during operation. The label 206 has a plurality of control temperature settings 208 arranged in a semicircle around a control knob 210. In a preferred embodiment, as is depicted in FIG. 8, the temperature settings 208 range from 200° F (93.3° C) to 400° F (204.4° C) and have intermediate temperature intervals of 10° F (5.5° C) marked by radially outwardly emanating lines on the face of the label 206. Alternatively, depending upon the range of control temperatures desired, limitations of the controller 128, the material being heated and applied, the flow rate of the material flowing through the hose 22 and wand 24, as well as other factors, the label 206 may bear a different temperature range. Routine testing and experimentation can be done to determine an optimum temperature range for different hot melt materials, different applications, different flow rates, different operating conditions, and for other factors.

[0142] The control knob 210 has an indicator arrow 212 which indicates the desired control setting of the temperature controller 128. To communicate the control setting to the temperature controller thermostat circuitry, the knob 210 preferably is attached to a shaft of an electrical component capable of selectively variable control that preferably is a variable resistor, a potentiometer, or the like, which sets the desired control temperature for the controller 128.

[0143] Alternatively, another means for setting the control temperature can be used. For example, a digital or analog input for inputting the control temperature can be used. If a digital input is used, it can, for example, comprise a pair of push buttons coupled to a digital readout that allows the control temperature to be increased when one of the buttons is pushed and to be decreased when the other of the buttons is pushed.

[0144] In one preferred embodiment of the temperature controller 128, selection of a control temperature using the knob 210 controls when the generator 166 is energized thereby controlling heating of the hose 22, wand 24 and hot melt mix material within the hose 22 and wand 24. For example, if the knob 210 is set to a control temperature of 200° F (93.3° C), such as is de-

picted in FIG. 8, the controller 128 can be programmed to energize the generator 166 when the hot melt mix hose temperature sensed by the thermocouple 122 and controller 128 drops to either (1) the control temperature or (2) to a predetermined temperature below the control temperature.

[0145] If the controller 128 is preprogrammed to energize the generator 166 when the hot melt mix temperature is below the control temperature, it can be preprogrammed to energize when the hot melt mix temperature reaches a certain preset temperature below the control temperature. For example, the controller 128 preferably can be preprogrammed or preset such that it energizes the generator 166 when the hot melt mix temperature is five, ten, fifteen or even twenty degrees below the control temperature.

[0146] Likewise, the controller 128 can be preprogrammed to deenergize the generator 166 when the hot melt mix temperature rises to be the same as the control temperature or when it reaches a temperature above the control temperature. In a preferred embodiment, the controller 128 deenergizes the generator 166 when the sensed hot melt mix hose temperature rises to a predetermined temperature above the control temperature. For example, the controller 128 can be preprogrammed or preset such that it deenergizes the generator 166 when the hot melt mix temperature is at a temperature that is five, ten, fifteen or even twenty degrees above the control temperature.

[0147] As such, the controller 128 can be programmed to have an upper setpoint control temperature that is above the control temperature set by the user 28 and a lower setpoint control temperature that can be the same as or below the control temperature set by a user 28 for enabling the controller 128 to control generator operation such that the hose 22, wand 24 and hot melt mix material within the hose 22 and wand 24 are sufficiently heated during operation. Preferably, these upper and lower setpoint temperatures "float" around or are indexed to the control temperature set by the user 28.

[0148] Preferably, the controller 128 has a thermostat circuit 230 of conventional construction for providing an upper and lower setpoint temperature that is tied to the control temperature set by the user 28. Preferably, the controller 128 is a PAKSTAT Model No. P64A0918904, made by Paktronics Controls, Inc. of Fort Worth, Texas and which provides these capabilities. Alternatively, the controller 128 can be another type of controller, such as for example a programmable controller capable of controlling generator operation based upon the sensed temperature of one or more of the following: the hose 22, the wand 24, the hose 22 and wand 24, the hot melt mix material within the hose 22 and/or wand 24, or a suitable combination thereof.

V. Engine Control

[0149] As is depicted in FIG. 9, in another preferred

embodiment of the controller 128', the controller 128' can be constructed and arranged to perform as part of an engine control system 226 to control operation of the engine 52 to help regulate the temperature of the hot melt mix material within the hose 22 and wand 24. To control operation of the engine 52, the controller 128' has a control line 218 in communication with an engine controller 220 that preferably is a throttle controller 222. Preferably, the throttle controller 222 selectively controls the speed of the engine 52 by directly controlling the position of the throttle of the engine 52 during operation. By directly controlling the speed of the engine 52 during operation, the amount of electrical power generated and supplied to the hose 22 and wand 24 can also be controlled thereby enabling heat input into the hose 22 and wand 24 to be regulated.

[0150] Preferably, the throttle controller 222 is a solenoid operably connected to the throttle of the engine 52, such as by being connected to the throttle cable of the engine 52 or the like. In response to a control signal from the controller 128 sent along control line 218, the throttle controller 222 changes position of the engine throttle by the solenoid being energized and moving the throttle. If desired, the control signal of the controller 128' can be directly applied to the solenoid itself to selectively control the position of the throttle. Alternatively, the throttle controller 222 can be integral with the controller 128'.

[0151] If desired, the speed of the engine 52 can be controlled and based upon the hot melt mix temperature sensed by the temperature sensor 122 with engine speed being increased if the sensed temperature is too low and being decreased if it is higher than necessary. For example, engine speed can be increased or decreased relative to a control temperature set and regulated in the manner discussed above.

[0152] Preferably, the speed of the engine 52 can be controlled based upon the load placed upon the generator 166 to ensure adequate electrical power is being supplied to the heating element of the hose 22 and wand 24. In one preferred embodiment, the controller 128' has a line 224 (in phantom) in electrical communication with one or more of the output terminals 172, 174, and 176 of the generator 166 or the heating element wires 98, 100 and 102 for sensing (1) voltage, (2) amperage, or (3) both voltage and amperage to ensure that the heating element 30 is generating an appropriate amount of heat for a given set of operating conditions.

[0153] If the electrical measurement sensed is too low, such as below a setpoint control voltage or current, the controller 128' speeds up the engine 52 to cause the generator 166 to output more electrical power to the heating element 30. Conversely, if the electrical measurement is too high, such as above a setpoint control voltage or current, the controller 128' reduces engine speed to cause less electrical power to be delivered to the heating element 30 thereby causing less heat to be applied to the hose 22 and wand 24.

[0154] In one preferred embodiment, the controller

128' regulates engine speed based upon the sensed output voltage of the generator 166. If, the output voltage should fall below a desired predetermined output voltage, the controller will increase engine speed thereby increasing the output voltage until it reaches or suitably exceeds the desired voltage. Conversely, if the output voltage is too great, the engine 52 is slowed preferably until the output voltage approaches or falls within an acceptable range of the desired preset voltage. In one preferred embodiment, the output voltage of the generator 166 is, for example, about thirty six volts for ensuring a heating element heating flux of about of about 3.5 watts per inch².

[0155] Additionally, the controller 128' can also function as temperature controller 128 by also controlling the operation of the generator 166 in the manner previously discussed. In combination, in response to the hot melt mix temperature and electrical output of the generator 166, the engine speed and generator operation can be suitably controlled to control heating of the hose 22 and wand 24 in a carefully controlled manner over a wide range of operating conditions and the like.

VI. Use and Operation

A. Use

[0156] In use, the three phase hose and wand heating system 160 of this invention, including the three phase generator 166, three phase heating element 30 and controller 128, is well suited for controlling the heating of the hose 22 and wand 24 of a hot melt mix applicator 20 that can dispense hot melt materials such as bitumen, tar, asphalt, asphalt mixtures, petroleum based mixtures, petroleum based sealants, thermoplastic sealants, thermoplastic paints, thermoplastic plastics, other thermoplastic materials and other materials which can be made flowable upon the application of heat. Preferably, the heating system 160 is particularly well suited for use in conventional hot melt mix applicators, asphalt dispensers, pavement crack sealing machines, and other types of thermoplastic material dispensers and applicators that use a hose 22, a wand 24, or both a hose 22 and wand 24 to effect dispensing of the thermoplastic material. Although well suited for use to heated mixtures of two or more materials, the wand and hose heating system 160 of this invention is also well suited for heating hot melt materials that are not mixtures. The engine speed control system 226 of this invention is also particularly well suited for these applications.

B. Operation

[0157] In preparation for startup, the switch 214 of the temperature controller 128 is turned to its "on" position and the control knob 210 is set at a desired control temperature for the particular material being applied by the hot melt mix applicator 20. Upon startup of the applicator

20, hot melt mix material inside the kettle 38, inside the hose 22 and inside the wand 24 is heated to or preferably above a temperature at which the hot melt mix material will flow.

[0158] To do this, the engine 52 is started, enabling three phase electrical power to be generated by the three phase generator 166. To determine whether the generator 166 will be energized, the temperature controller 128 communicates with the temperature sensor 122 to determine the temperature of the hose 22 and hot melt mix within the hose 22 that is adjacent the sensor 122. If the temperature is below the control temperature or below its lower setpoint temperature, the generator 166 is energized by the controller 128 causing current flow in each of the three phase heating element wires 98, 100 and 102 which heats the hose 22 and wand 24.

[0159] As the hot melt mix material within the hose 22 and wand 24 is heated, the hot melt mix material begins to melt making it flowable. After a sufficient heating interval of time has elapsed, the hot melt mix within both the hose 22 and wand 24 will be sufficiently hot such that it will flow. Preferably, when the hot melt mix material within the hose 22 and wand 24 has reached a flowable state and the temperature controller 128 senses that the hot melt mix temperature has reached the upper setpoint temperature, the controller 128 deenergizes the generator 166 thereby ceasing current flow to the heating element 30.

[0160] If desired, the controller 128 can provide a signal to the operator 28, in the form of an indicator light or otherwise (not shown), that the hot melt mix material within the hose 22 and wand 24 have reached the desired temperature and is in a flowable state. If desired, to expedite heating of the hot mix material during startup until it reaches a flowable state, the controller 128 can communicate with the engine 52 to cause the engine 52 to run at least slightly faster than normal.

[0161] In operation, as hot melt mix material is pumped from the kettle 38, it flows through the hose 22 and is dispensed from the duckbill valve 72 at the end of the wand 24 onto a surface that preferably is pavement, roadway or the like. Should the temperature of the hot melt mix material within the hose 22 drop below the lower control temperature or lower setpoint temperature, the controller 128 activates the generator 166 thereby supplying current to each of the wires 98, 100 and 102 of the heating element 30 causing hot melt mix material within the hose 22 and wand 24 to be heated. When the temperature of the sensor 122 reaches the upper setpoint temperature, the controller 128 deenergizes the generator 166 ceasing current flow to the heating element 30.

[0162] The control system 160 is particularly well suited for keeping the hot melt mix material within the hose 22 and wand 24 in a flowable state during periods of inactivity, such as when the applicator 20 is operating but no hot melt mix is being dispensed. When the appli-

cator 20 is operating and no hot melt mix is being dispensed, hot melt mix is not flowing through the hose 22 and wand 24 and can therefore cool within the hose 22 and wand 24 causing some solidification. During these periods, the three phase heating system 160 advantageously maintains the hot melt mix material at a temperature at which it will readily flow despite the cooling that ordinarily takes place.

[0163] Although the aforementioned heating system 160 is designed to controllably heat both the hose 22 and wand 24, it is within the contemplated scope of the invention to modify the system 160 to controllably heat only the hose 22, only the wand 24, or both the hose 22 and wand 24 independently of each other. If heated independently of each other, the hose 22 preferably has its own heating element and temperature sensor and the wand 24 preferably has its own heating element and sensor, with current flow controlled such that it can be delivered to one of the heating elements independently of the other heating elements.

[0164] It is also to be understood that, although the foregoing description and drawings describe and illustrate in detail one or more embodiments of the present invention, to those skilled in the art to which the present invention relates, the present disclosure will suggest many modifications and constructions as well as widely differing embodiments and applications without thereby departing from the scope of the invention. The present invention, therefore, is intended to be limited only by the scope of the appended claims.

Claims

1. A hot melt mix applicator (20) for dispensing heated, flowable material comprising:

a source (38) of heated flowable material;
 a dispenser (68) for dispensing said flowable material;
 a flexible hose (22, 22') having one end in communication with said source (38) of heated flowable material and its other end in fluid flow communication with said dispenser (68) for conducting heated flowable material from said heated flowable material source (38) to said dispenser (68);
 a pump (48) for urging said flowable material through said flexible hose (22, 22') to said dispenser (68);
 a source (114) of electrical current; and
 heating element wiring (30) electrically coupled to said electrical current source (114);

characterised in that said hose (22, 22') comprises an elongated outer tubular flexible casing (310), an elongate tubular flexible inner conduit (82) received within said casing (310), and an elongated

flexible tube (270) slidably telescopically received within said flexible inner conduit (82) through which flowable material flows; wherein said heating element wiring (30) is wrapped around said flexible inner conduit (82).

2. The hot melt mix applicator of claim 1 comprising a source (114) of three phase electrical current; and an electric three phase heating element (30) supplied with three phase electrical current from said three phase current source and in thermal relation with said hose (22, 22') for heating flowable material in said hose.
3. The hot melt mix applicator of claim 2 comprising a temperature controller (128, 128') for controlling heating of said flowable material in said conduit (82) by controlling heating of said heating element; a temperature sensor (122) in co-operation with said conduit (82) and electrically coupled to said temperature controller (128, 128') for sensing the temperature of flowable material in said conduit (82) adjacent said sensor (122) and communicating said temperature to said controller (128); and wherein said temperature controller (128, 128') is electrically coupled to said three phase generator (114) for selectively energising said generator (114) in response to said temperature sensed by said sensor (122) to control heating of said flowable material in said conduit (82) to cause said generator (114) to generate and supply three phase electrical power to said heating element (30) when energised.
4. The hot melt mix applicator of claim 2 or 3 wherein said inner flexible conduit (82) of hollow and elongated construction comprised of a sidewall (84) of generally cylindrical cross-section and wherein a three phase heating element cord (30, 94) is wrapped in a spiral around at least a portion of said conduit (82) with adjacent loops of said cord (30, 94) spaced apart by a distance of between 12.7 mm and 25.4 mm to produce a heating flux of between about 0.3875 watts per square centimeter and 0.5425 watts per square centimeter.
5. The hot melt mix applicator of any one of claims 2 to 4 wherein said three phase current is supplied to said heating element (30) at an electrical potential no greater than about 60 volts between any two phases for reducing the risk of electrical shock.
6. The hot melt mix applicator of any one of claims 2 to 5 wherein said dispenser (68) comprises an elongated tubular wand (24) and said three phase heating element comprises a cord (30) containing three wires each carrying a phase of current with said cord helically wrapped around said wand (24) for heating flowable material within said wand.

7. The hot melt mix applicator of any one of claims 2 to 6 further comprising a support frame (32) carrying said source (38) of flowable material, said pump, (48) and said three phase current source (114) and wherein said source of three phase electrical current comprises an internal combustion engine (52) having an output in co-operation with a three phase alternating current generator (106) for providing three phase electrical current to said heating element wires (30). 5
8. The hot melt mix applicator of claim 7 wherein said generator (114) supplies electrical current directly to said heating element (30) without requiring an electrical current regulator or a voltage regulator to be in electrical communication with said generator (166) or said heating element (30). 10
9. The hot melt mix applicator of claim 7 or 8 wherein said generator (166) comprises a vehicle alternator (194) coupled to an output shaft of said engine (52). 15
10. The hot melt mix applicator of claim 9 wherein said alternator (194) lacks power electronics components for converting three phase current to single phase or direct current. 20
11. The hot melt mix applicator of claim 1 wherein said dispenser (68) comprises an elongated tubular wand (24) coupled to said conduit (82) and said heating element wires are wrapped in a spiral around said wand substantially the length of said wand (24) for heating flowable material within said wand (24). 25
12. The hot melt mix applicator of claim 3 wherein said temperature sensor (122) is carried by said inner conduit (82) and spaced a distance of at least about 152.4 millimetres from said end of said hose (22, 22') for sensing the temperature of said inner conduit (82). 30
13. The hot melt mix applicator of any one of claims 7 to 12 wherein said heating element wires (30) are connected at one end to said three phase generator (166) and to each other at their opposite ends. 35
14. The hot melt mix applicator of any one of claims 7 to 13 wherein said three phase generator (106) has (1) a rotor (170) connected to said heating element (30) for supplying three phase electrical current to said heating element when said generator (166) is energised and generating electrical power, (2) a stator (168) in electrical communication with said temperature controller (128, 128') and said stator (168) having an output in communication with an input of said rotor, and (3) wherein said rotor (170) and stator (168) is constructed and arranged such that said controller (128, 128') energises said generator (166) causing said generator (166) to generate and supply three phase electrical current to said heating element (30) by said controller (128, 128') supplying a control current from said output of said controller to said input of said stator. 40
15. The hot melt mix applicator of any one of claims 7 to 14 further comprising (1) a throttle in co-operation with said engine speed for controlling engine speed, (2) a solenoid coupled to said throttle; (3) a temperature controller electrically coupled to said solenoid (222); (4) a temperature sensor (122) carried by said conduit (82) and electrically coupled to said temperature controller (128, 128') for sensing the temperature of flowable material in said conduit (82) adjacent said sensor and communicating an electrical signal representative of said temperature to said controller; and (5) wherein said controller controls engine speed in response to the temperature sensed by said temperature sensor to control heating of said heating element (30). 45
16. The hot melt mix applicator of any one of claims 7 to 14 further comprising (1) a throttle in co-operation with said engine speed for controlling engine speed, (2) a solenoid (222) coupled to said throttle; (3) a temperature controller (128, 128') electrically coupled to said solenoid (222) and electrically coupled to said heating element (30) for sensing the magnitude of the voltage or current of said heating element; and (4) wherein said controller (128) controls engine speed in response to the magnitude of said voltage or current sensed to control heating of said heating element. 50
17. The hot melt mix applicator of any one of claims 1 to 16 wherein a fitting assembly (80, 80') is attached to each end of said flexible inner conduit (82'). 55
18. The hot melt mix applicator of any one of claims 1 to 17 wherein said outer casing (310) comprises a flexible rubber sidewall of generally cylindrical construction and a steel reinforcing wire (314) embedded within said sidewall for preventing crushing and kinking of said casing (310), inner conduit (82) and tubing (270).
19. The hot melt mix applicator of claim 17 wherein one end of said casing (310) is immovably fixed to one of said fitting assemblies (80, 80') and the other end of said casing is immovably fixed to the other end of said fitting assemblies for transferring hose tension from one of said fitting assemblies through said casing (310) to the other of said fitting assemblies and away from said flexible inner conduit (82).
20. The hot melt mix material applicator of any one of

claims 1 to 19 wherein said tube (270) comprises an axially compressible bendable flexible metal tube made from a single elongated helically interlocked strip (274) of metal and wherein said tube is axially compressed within said flexible inner conduit (82) when received within said flexible inner conduit (82).

21. The hot melt mix material applicator of any one of claims 1 to 20 wherein said heating element (30) comprises three wires (96, 98, 100, 102) each carrying a phase of three phase electrical current and each of said wires is wrapped in a spiral around said flexible inner conduit (82) substantially the axial length of said conduit (82) for heating said conduit and flowable material within said tube (270).
22. The hot melt mix applicator of claim 1 further comprising a frame (32) carrying said source (38) of heated flowable material and said pump (48), and wherein said source (114) of electrical current comprises an internal combustion engine (52) carried by said frame (32) and having its output coupled to an alternator (194) electrically connected to each of said heating element wires (30).

Patentansprüche

1. Aufbringvorrichtung (20) für eine Heißschmelzmischung, um erwärmtes, fließfähiges Material auszugeben, mit:
 - einem Vorrat (38) aus erwärmtem, fließfähigen Material;
 - einer Ausgabeeinrichtung (68) zum Ausgeben des fließfähigen Materials;
 - einem flexiblen Schlauch (22, 22'), der mit einem Ende in Verbindung mit dem Vorrat (38) des erwärmten, fließfähigen Material steht und der mit seinem anderen Ende in Strömungsverbindung mit der Ausgabeeinrichtung (68) steht, um erwärmtes, fließfähiges Material aus dem Vorrat (38) für erwärmtes, fließfähiges Material zur Ausgabeeinrichtung (68) zu leiten;
 - einer Pumpe (48), um das fließfähige Material durch den flexiblen Schlauch (22, 22') zur Ausgabeeinrichtung (68) zu drücken;
 - einer elektrischen Stromquelle (114); und
 - einer Heizelementverdrahtung (30), die elektrisch mit der elektrischen Stromquelle (114) verbunden ist;

dadurch gekennzeichnet, dass der Schlauch (22, 22') ein langgestrecktes, äußeres, rohrförmiges, flexibles Gehäuse (310), eine langgestreckte, rohrförmige, flexible, innere Leitung (82), die im Gehäuse (310) aufgenommen ist, und ein langgestrecktes, flexibles Rohr (270) aufweist, das teleskopisch gleitend innerhalb der flexiblen, inneren Leitung (32) aufgenommen ist, durch das fließfähiges Material fließt; wobei die Heizelementverdrahtung (30) um die flexible, innere Leitung (82) geschlungen ist.

2. Aufbringvorrichtung für Heißschmelzmischung nach Anspruch 1 umfassend eine elektrische Drehstromquelle (114); und ein elektrisches Dreiphasen-Heizelement (30), die mit dem elektrischen Drehstrom aus der Drehstromquelle versorgt wird und in Wärmebeziehung mit dem Schlauch (22, 22') steht, um das fließfähige Material im Schlauch zu erwärmen.
3. Aufbringvorrichtung für Heißschmelzmaterial gemäß Anspruch 2, umfassend eine Temperaturregelung (128, 128') zum Steuern des Erwärms des fließfähigen Materials in der Leitung (82) durch ein kontrolliertes Erwärmen des Heizelementes; einen Temperatursensor (122) in Zusammenwirkung mit der Leitung (82) und elektrisch mit der Temperaturregelung (128, 128') gekoppelt, um die Temperatur des fließfähigen Materials in der Leitung (82) benachbart dem Sensor (122) festzustellen und die Temperatur an die Steuerung (128) zu übermitteln; und wobei die Temperaturregelung (128, 128') elektrisch mit dem Dreiphasengenerator (114) gekoppelt ist, um in ausgewählter Weise den Generator (114) in Abhängigkeit von der durch den Sensor (122) festgestellten Temperatur anzuschalten, um das Erwärmen des fließfähigen Materials in der Leitung (82) zu steuern, um zu bewirken, dass der Generator (114), wenn er angeschaltet ist, elektrischen Dreiphasen-Strom erzeugt und dem Heizelement (30) zuführt.
4. Aufbringvorrichtung für Heißschmelzmischung nach Anspruch 2 oder 3, wobei die innere, flexible Leitung (82) aus einer hohlen und langgestreckten Konstruktion aus einer Seitenwand (84) mit im Wesentlichen zylindrischem Querschnitt besteht, und wobei ein Dreiphasen-Heizelementestrand (30, 94) spiralförmig um mindestens einen Bereich der Leitung (82) gewickelt ist, wobei benachbarte Schlaufen des Strangs (30, 94) durch einen Abstand zwischen 12,7 mm und 25,4 mm zueinander beabstandet sind, um einen Wärmefluss zwischen etwa 0,3875 W/cm² und 0,5425 W/cm² zu erzeugen.
5. Aufbringvorrichtung für Heißschmelzmischung nach einem der Ansprüche 2 bis 4, wobei der Drei-

phasenstrom dem Heizelement (30) mit einem elektrischen Potential nicht höher als etwa 60 V zwischen jeweils zwei Phasen zugeführt wird, um das Risiko eines elektrischen Schlags zu reduzieren.

6. Aufbringvorrichtung für Heißschmelzmischung nach einem der Ansprüche 2 bis 5, wobei die Ausgabeeinrichtung (68) eine langgestreckte, rohrförmige Lanze (24) umfasst, und wobei das Dreiphasen-Heizelement einen Strang (30) mit drei Drähten umfasst, von denen jeder eine Stromphase trägt, wobei der Strang um die Lanze (24) schraubenförmig herumgewickelt ist, um das fließfähige Material innerhalb der Lanze zu erwärmen.
7. Aufbringvorrichtung für Heißschmelzmischung nach einem der Ansprüche 2 bis 6 ferner umfassend einen Tragrahmen (32), der den Vorrat (38) an fließfähigem Material, die Pumpe (48) und die Drehstromquelle (114) trägt, und wobei die Drehstromquelle einen Verbrennungsmotor (52) umfasst, der einen Ausgang in Zusammenwirkung mit einem Dreiphasen-Wechselstromgenerator (106) aufweist, um die Heizelementdrähte (30) mit Drehstrom zu versorgen.
8. Aufbringvorrichtung nach Anspruch 7, wobei der Generator (114) elektrischen Strom direkt dem Heizelement (30) zuführt, ohne dass ein Strom- oder Spannungsregulator sich in elektrischer Verbindung mit dem Generator (166) oder dem Heizelement (30) befindet.
9. Aufbringvorrichtung für Heißschmelzmischung nach Anspruch 7 oder 8, wobei der Generator (166) eine Fahrzeuglichtmaschine (194) umfasst, die mit einer Ausgangswelle des Motors (52) gekoppelt ist.
10. Aufbringvorrichtung für Heißschmelzmischung nach Anspruch 9, wobei die Lichtmaschine (195) keine elektronischen Komponenten zum Umwandeln des Dreiphasenstroms in einen Einzelphasen- oder Gleichstrom enthält.
11. Aufbringvorrichtung für Heißschmelzmischung nach Anspruch 1, wobei die Ausgabeeinrichtung (68) eine langgestreckte, rohrförmige Lanze (24) aufweist, die mit der Leitung (82) gekoppelt ist, und wobei die Heizelementdrähte spiralig um die Lanze im Wesentlichen über die Länge der Lanze (24) gewickelt sind, um fließfähiges Material innerhalb der Lanze (24) zu erwärmen.
12. Aufbringvorrichtung für Heißschmelzmischung nach Anspruch 3, wobei der Temperatursensor (122) durch die innere Leitung (82) getragen und mit einem Abstand von mindestens etwa 152,4 mm vom Ende des Schlauchs (22, 22') beabstandet ist,

um die Temperatur der inneren Leitung (82) festzustellen.

13. Aufbringvorrichtung für Heißschmelzmischung nach einem der Ansprüche 7 bis 12, wobei die Heizelementdrähte (30) an einem Ende mit dem Dreiphasengenerator (166) und an ihren gegenüberliegenden Enden miteinander verbunden sind.
14. Aufbringvorrichtung für Heißschmelzmischung nach einem der Ansprüche 7 bis 13, wobei der Dreiphasengenerator (106) aufweist (1) einen Rotor (170), der mit dem Heizelement (30) zum Versorgen des Heizelementes mit Drehstrom verbunden ist, wenn der Generator (166) angeschaltet ist und Elektroenergie erzeugt, (2) einen Stator (168) in elektrischer Verbindung mit der Temperatursteuerung (128, 128') und wobei der Stator (168) einen Ausgang in Verbindung mit einem Eingang des Rotors aufweist, und (3), wobei der Rotor (170) und der Stator (168) so konstruiert und angeordnet sind, dass die Steuerung (128, 128') den Generator (166) anschaltet, was den Generator (166) veranlasst, Drehstrom zu erzeugen und an das Heizelement (30) zu liefern, durch die Steuerung (128, 128'), die einen Steuerstrom vom Ausgang der Steuerung an den Eingang des Stators überträgt.
15. Aufbringvorrichtung für Heißschmelzmischung nach einem der Ansprüche 7 bis 14, ferner umfassend (1) eine Ventilklappe in Zusammenwirkung mit der Motorgeschwindigkeit zum Steuern der Motorgeschwindigkeit, (2) ein Solenoid, gekoppelt mit der Ventilklappe; (3) eine Temperatursteuerung, die elektrisch mit dem Solenoid (222) gekoppelt ist; (4) einen Temperatursensor (122), der durch die Leitung (82) getragen ist und elektrisch mit der Temperatursteuerung (128, 128') gekoppelt ist, um die Temperatur des fließfähigen Materials in der Leitung (82) benachbart dem Sensor festzustellen und ein elektrisches Signal, das repräsentativ für diese Temperatur ist, an die Steuerung zu übermitteln; und (5) wobei die Steuerung die Motorgeschwindigkeit in Abhängigkeit durch die durch den Temperatursensor festgestellte Temperatur steuert, um die Heizwirkung des Heizelements (30) zu steuern.
16. Aufbringvorrichtung für Heißschmelzmischung nach einem der Ansprüche 7 bis 14, ferner umfassend (1) eine Drosselklappe in Zusammenwirkung mit der Motorgeschwindigkeit zum Steuern der Motorgeschwindigkeit, (2) ein Solenoid (222), gekoppelt mit der Drosselklappe; (3) eine Temperatursteuerung (128, 128'), die elektrisch mit dem Solenoid (222) gekoppelt ist und die elektrisch mit dem Heizelement (30) gekoppelt ist, um den Spitzenwert der Spannung oder des Stroms des Heizelementes festzustellen; und (4) wobei die Steuerung (128) die

Motorgeschwindigkeit in Abhängigkeit vom festgestellten Spitzenwert der Spannung oder des Stroms steuert, um die Heizwirkung des Heizelementes zu steuern.

17. Aufbringvorrichtung für Heißschmelzmischung nach einem der Ansprüche 1 bis 16, wobei eine Verbindereinrichtung (80, 80') an jedem Ende der flexiblen, inneren Leitung (82') angeordnet ist.

18. Aufbringvorrichtung für Heißschmelzmischung nach einem der Ansprüche 1 bis 7, wobei das äußere Gehäuse (310) eine flexible Gummiseitenwand einer im allgemeinen zylindrischen Ausbildung und einen Stahlverstärkungsdraht (314) aufweist, der in die Seitenwand eingebettet ist, um ein Zusammenquetschen und Knicken des Gehäuses (310), der inneren Leitung (82) und der Rohrleitung (270) zu verhindern.

19. Aufbringvorrichtung für Heißschmelzmischung nach Anspruch 17, wobei ein Ende des Gehäuses (310) unbewegbar mit einem der Verbindereinheiten (80, 80') und das andere Ende des Gehäuses unbeweglich mit dem anderen Ende der Verbindungseinrichtungen verbunden ist, um die Schlauchspannung von einem der Verbindungseinrichtungen über das Gehäuse (310) auf die andere der Verbindungseinrichtungen und von der flexiblen, inneren Leitung (82) weg zu übertragen.

20. Aufbringvorrichtung für Heißschmelzmischungsmaterial nach einem der Ansprüche 1 bis 19, wobei die Rohrleitung (270) ein axial komprimierbares, biegbares, flexibles Metallrohr umfasst, hergestellt aus einem einzigen, langgestreckten, schraubenförmig ineinander verriegelten Streifen (274) aus Metall, und wobei das Rohr axial innerhalb der flexiblen, inneren Leitung (82) komprimiert ist, wenn es innerhalb der flexiblen, inneren Leitung (82) aufgenommen ist.

21. Aufbringvorrichtung für Heißschmelzmischungsmaterial nach einem der Ansprüche 1 bis 20, wobei das Heizelement (30) drei Drähte (96, 98, 100, 102) aufweist, von denen jeder eine Phase des elektrischen Dreiphasenstroms erhält, und wobei jeder der Drähte spiralförmig um die flexible, innere Leitung (82) im Wesentlichen über die axiale Länge der Leitung (82) gewickelt ist, um die Leitung und das fließfähige Material innerhalb der Rohrleitung (270) zu erwärmen.

22. Aufbringvorrichtung für Heißschmelzmischung nach Anspruch 1, ferner umfassend einen Rahmen (32), der den Vorrat (38) des erwärmten, fließfähigen Materials und die Pumpe (48) trägt, und wobei die Stromquelle (114) eine Verbrennungsmaschine

(52) umfasst, die durch den Rahmen (32) getragen wird und mit ihrem Ausgang mit einer Lichtmaschine (194) gekoppelt ist, die elektrische mit jedem der Heizelementdrähte (30) verbunden ist.

Revendications

1. Appareil (20) d'un mélange thermofusible destiné à distribuer une matière fluide chauffée, comprenant :

une source (38) de matière fluide chauffée, un distributeur (68) destiné à distribuer la matière fluide, un tube souple (22, 22') ayant une première extrémité qui communique avec la source (38) de matière fluide chauffée et une autre extrémité qui communique pour la circulation du fluide avec le distributeur (68) afin qu'il conduise la matière fluide chauffée de la source (38) de matière fluide chauffée au distributeur (68), une pompe (48) destinée à rappeler la matière fluide par le tube souple (22, 22') vers le distributeur (68), une source (114) de courant électrique, et un câblage (30) d'élément de chauffage couplé électriquement à la source de courant électrique (114),

caractérisé en ce que le tube souple (22, 22') comprend une enveloppe souple tubulaire externe allongée (310), un conduit interne souple tubulaire allongé (82) logé dans l'enveloppe (310), et un tuyau souple allongé (270) logé télescopiquement afin qu'il coulisse dans le conduit interne souple (82) dans lequel s'écoule la matière fluide, le câblage (30) d'élément de chauffage étant enveloppé autour du conduit interne souple (82).

2. Appareil d'un mélange thermofusible selon la revendication 1, comprenant une source (114) de courant électrique triphasé, et

un élément triphasé de chauffage électrique (30) alimenté en courant électrique triphasé par la source de courant triphasé et en relation thermique avec le tube souple (22, 22') pour le chauffage de la matière fluide dans le tube souple.

3. Appareil d'un mélange thermofusible selon la revendication 2, comprenant un organe de réglage de température (128, 128') destiné à régler le chauffage de la matière fluide dans le conduit (82) par réglage du chauffage de l'élément de chauffage, et

un capteur (122) de température en coopération avec le conduit (82) et couplé électriquement à l'organe de réglage de température (128, 128') pour la détection de la température de la matière fluide

dans le conduit (82) près du capteur (122) et communiquant la température à l'organe de réglage (128), et

dans lequel l'organe de réglage de température (128, 128') est couplé électriquement au générateur triphasé (114) pour l'alimentation sélective du générateur (114) en fonction de la température détectée par le capteur (122) afin que le chauffage de la matière fluide dans le conduit (82) soit réglé et que le générateur (114) crée et transmette de l'énergie électrique triphasée à l'élément de chauffage (30) lors de son alimentation.

4. Applicateur d'un mélange thermofusible selon la revendication 2 ou 3, dans lequel le conduit souple interne (82) de construction creuse et allongée est formé d'une paroi latérale (84) de section cylindrique de façon générale, et un cordon (30, 94) d'élément de chauffage triphasé est enveloppé en spirale autour d'une partie au moins du conduit (82) avec des boucles adjacentes du cordon (30, 94) qui sont séparées par une distance comprise entre, 12,7 et 25,4 mm pour la production d'un flux de chaleur compris entre environ 0,3875 et 0,5425 W/cm².
5. Applicateur d'un mélange thermofusible selon l'une quelconque des revendications 2 à 4, dans lequel le courant triphasé est transmis à l'élément de chauffage (30) à un potentiel électrique qui ne dépasse pas 60 V environ entre deux phases quelconques afin que le risque de choc électrique soit réduit.
6. Applicateur d'un mélange thermofusible selon l'une quelconque des revendications 2 à 5, dans lequel le distributeur (68) comporte une barre tubulaire allongée (24) et l'élément triphasé de chauffage comprend un cordon (30) qui contient trois filtres transportant chacun une phase du courant, le cordon étant enveloppé en hélice autour de la barre (24) pour le chauffage de la matière fluide présente dans la barre.
7. Applicateur d'un mélange thermofusible selon l'une quelconque des revendications 2 à 6, comprenant en outre un châssis de support (32) portant la source (38) de matière fluide, la pompe (48) et la source de courant triphasé (114), et dans lequel la source de courant électrique triphasé comporte un moteur à combustion interne (52) dont la sortie coopère avec une génératrice (106) de courant alternatif triphasé pour la transmission du courant électrique triphasé aux fils (30) de l'élément de chauffage.
8. Applicateur d'un mélange thermofusible selon la revendication 7, dans lequel le générateur (114) transmet un courant électrique directement à l'élément de chauffage (30) sans nécessiter de régula-

teur de courant électrique ou de régulateur de tension en communication électrique avec le générateur (166) ou avec l'élément de chauffage (30).

9. Applicateur d'un mélange thermofusible selon la revendication 7 ou 8, dans lequel la génératrice (166) est un alternateur (194) de véhicule couplé à un arbre de sortie du moteur (52).
10. Applicateur d'un mélange thermofusible selon la revendication 9, dans lequel l'alternateur (194) n'a pas de composants électroniques de puissance pour la transformation d'un courant triphasé en courant monophasé ou continu.
11. Applicateur d'un mélange thermofusible selon la revendication 1, dans lequel le distributeur (68) comporte une barre tubulaire allongée (24) couplée au conduit (82), et les fils de l'élément de chauffage sont enveloppés en spirale autour de la barre pratiquement sur la longueur de la barre (24) pour le chauffage de la matière fluide dans la barre (24).
12. Applicateur d'un mélange thermofusible selon la revendication 3, dans lequel le capteur de température (122) est porté par le conduit interne (82) et est placé à une distance d'environ 152,4 mm au moins de l'extrémité du tube souple (22, 22') pour la détection de la température du conduit interne (82).
13. Applicateur d'un mélange thermofusible selon l'une quelconque des revendications 7 à 12, dans lequel les fils (30) d'élément de chauffage sont connectés à une première extrémité à la génératrice triphasée (166) et les uns aux autres à leurs extrémités opposées.
14. Applicateur d'un mélange thermofusible selon l'une quelconque des revendications 7 à 13, dans lequel le générateur triphasé (106) comporte (1) un rotor (170) connecté à l'élément de chauffage (30) pour la transmission d'un courant électrique triphasé à l'élément de chauffage lorsque la génératrice (166) est alimentée et créant de l'énergie électrique, (2) un stator (168) en communication électrique avec l'organe de réglage de température (128, 128') et le stator (168) ayant une sortie qui communique avec une entrée du rotor, et (3) dans lequel le rotor (170) et le stator (168) sont construits et disposés de manière que l'organe de réglage (128, 128') alimente la génératrice (166) en provoquant la création et la transmission par la génératrice (166) d'un courant électrique triphasé vers l'élément de chauffage (30) lorsque l'organe de réglage (128, 128') transmet un courant de réglage de la sortie de l'organe de réglage à l'entrée du stator.
15. Applicateur d'un mélange thermofusible selon l'une

- quelconque des revendications 7 à 14, comprenant en outre (1) un papillon des gaz en coopération avec la vitesse du moteur pour le réglage de la vitesse du moteur, (2) un électro-aimant couplé au papillon des gaz, (3) un organe de réglage de température couplé électriquement à l'électro-aimant (222), (4) un capteur de température (122) porté par le conduit (82) et couplé électriquement à l'organe de réglage de température (128, 128') pour la détection de la température de la matière fluide dans le conduit (82) près du capteur et communiquant un signal électrique représentatif de la température à l'organe de réglage, et (5) dans lequel l'organe de réglage règle la vitesse du moteur en fonction de la température détectée par le capteur de température pour le réglage du chauffage de l'élément de chauffage (30).
16. Applicateur d'un mélange thermofusible selon l'une quelconque des revendications 7 à 14, comprenant en outre (1) un papillon des gaz en coopération avec la vitesse du moteur pour le réglage de la vitesse du moteur, (2) un électro-aimant (222) couplé au papillon des gaz, (3) un organe de réglage de température (128, 128') couplé électriquement à l'électro-aimant (222) et couplé électriquement à l'élément de chauffage (30) afin qu'il détecte l'amplitude de la tension ou l'intensité du courant de l'élément de chauffage, et (4) dans lequel l'organe de réglage (128) règle la vitesse du moteur en fonction de l'amplitude de la tension ou de l'intensité du courant détecté pour le réglage du chauffage de l'élément de chauffage.
17. Applicateur d'un mélange thermofusible selon l'une quelconque des revendications 1 à 16, dans lequel un ensemble d'ajustement (80, 80') est fixé à chaque extrémité du conduit interne souple (82').
18. Applicateur d'un mélange thermofusible selon l'une quelconque des revendications 1 à 17, dans lequel l'enveloppe externe (310) comporte une paroi latérale de caoutchouc souple de construction cylindrique de façon générale et un fil d'acier d'armature (314) enrobé dans la paroi latérale et destiné à empêcher l'écrasement de l'enveloppe (310), du conduit interne (82) et du tuyau (270) en empêchant la formation de cosses.
19. Applicateur d'un mélange thermofusible selon la revendication 17, dans lequel une première extrémité de l'enveloppe (310) est fixée de façon immobile à l'un des ensembles d'ajustement (80, 80') et l'autre extrémité de l'enveloppe est fixée de façon immobile à l'autre extrémité des ensembles d'ajustement pour le transfert de la tension du tube souple de l'un des ensembles d'ajustement, par l'intermédiaire de l'enveloppe (310) à l'autre des ensembles d'ajuste-
- ment et loin du conduit interne souple (82).
20. Applicateur d'un mélange thermofusible selon l'une quelconque des revendications 1 à 19, dans lequel le tuyau (270) comporte un tuyau métallique souple qui peut fléchir avec compression axiale, formé d'une seule bande allongée emboîtée en hélice (274) d'un métal, et dans lequel le tuyau est comprimé axialement dans le conduit interne souple (82) lorsqu'il est logé dans le conduit interne souple (82).
21. Applicateur d'un mélange thermofusible selon l'une quelconque des revendications 1 à 20, dans lequel l'élément de chauffage (30) comporte trois fils (96, 98, 100, 102) transportant chacun une des trois phases du courant électrique triphasé et chacun des fils est enveloppé en spirale autour du conduit interne souple (82) pratiquement sur la longueur axiale du conduit (82) pour le chauffage du conduit et de la matière fluide placée dans le tuyau (270).
22. Applicateur d'un mélange thermofusible selon la revendication 1, comprenant en outre un châssis (32) portant la source (38) de matière fluide chauffée et la pompe (48), et dans lequel la source (114) d'un courant électrique comporte un moteur à combustion interne (52) porté par le châssis (32) et ayant sa sortie couplée à un alternateur (194) connecté électriquement à chacun des fils d'élément de chauffage (30).

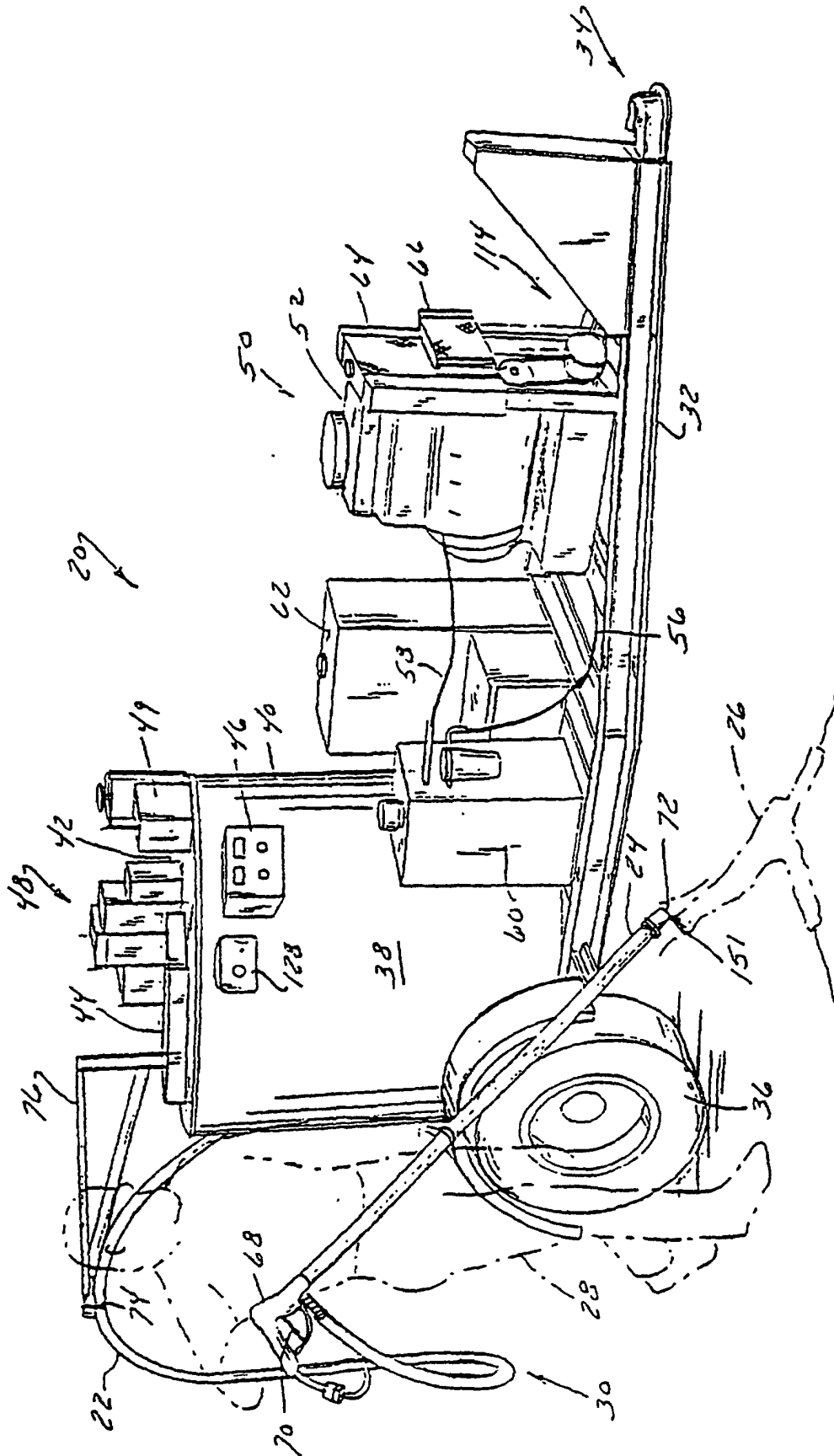


FIG. 1

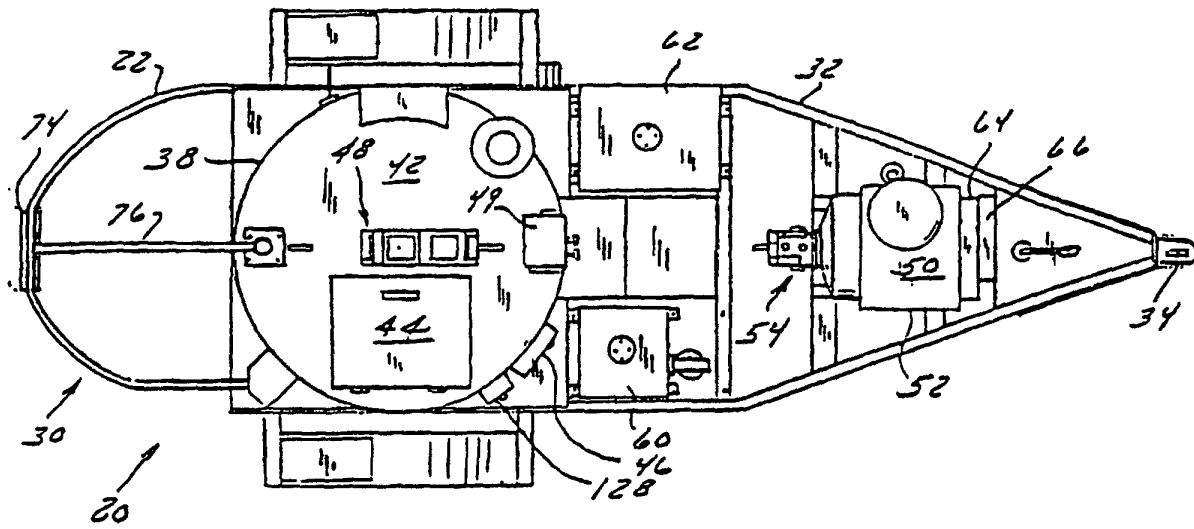


FIG. 3

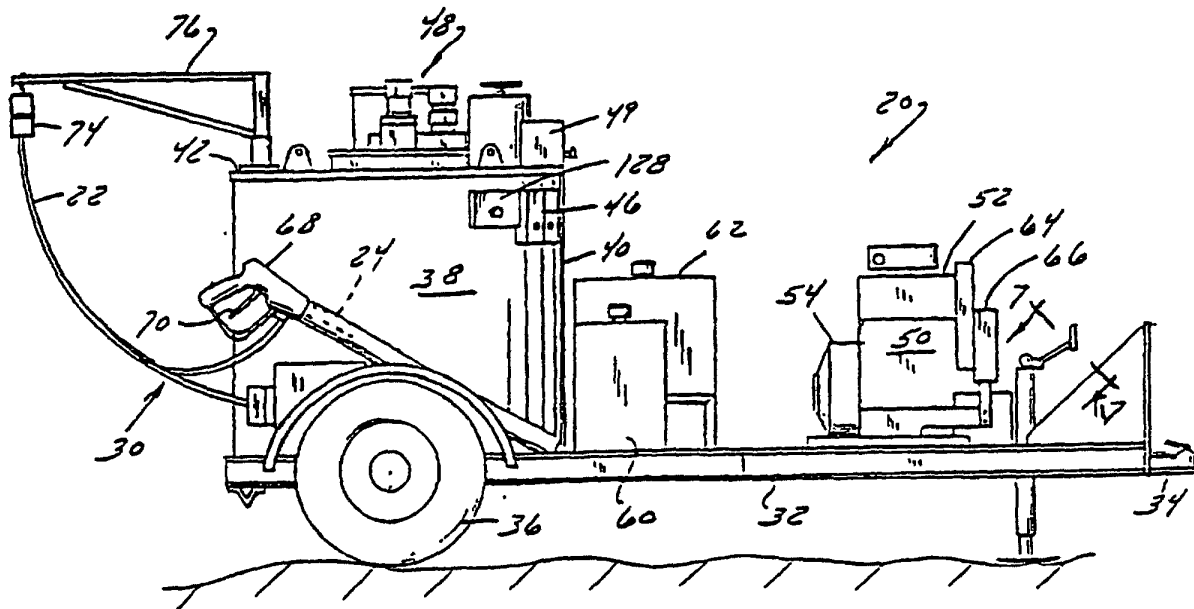


FIG. 2

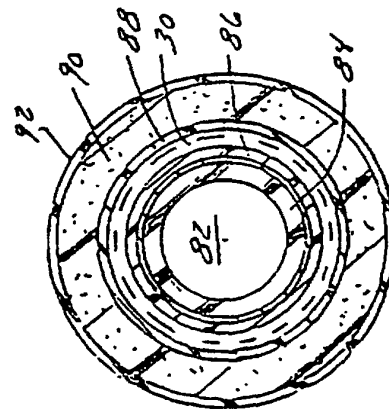
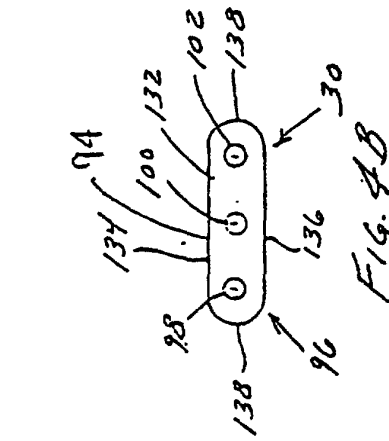
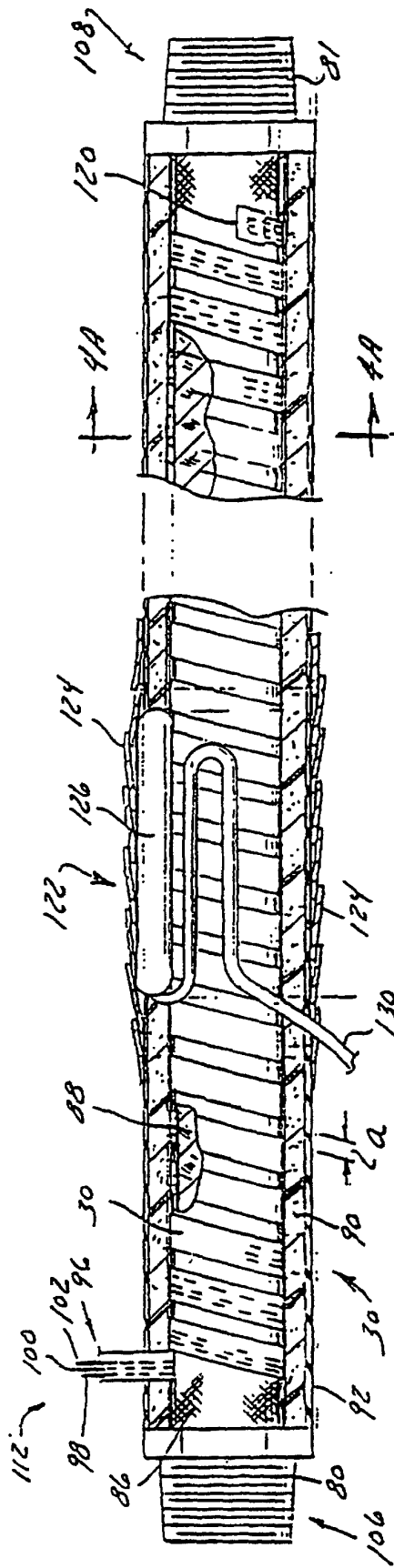
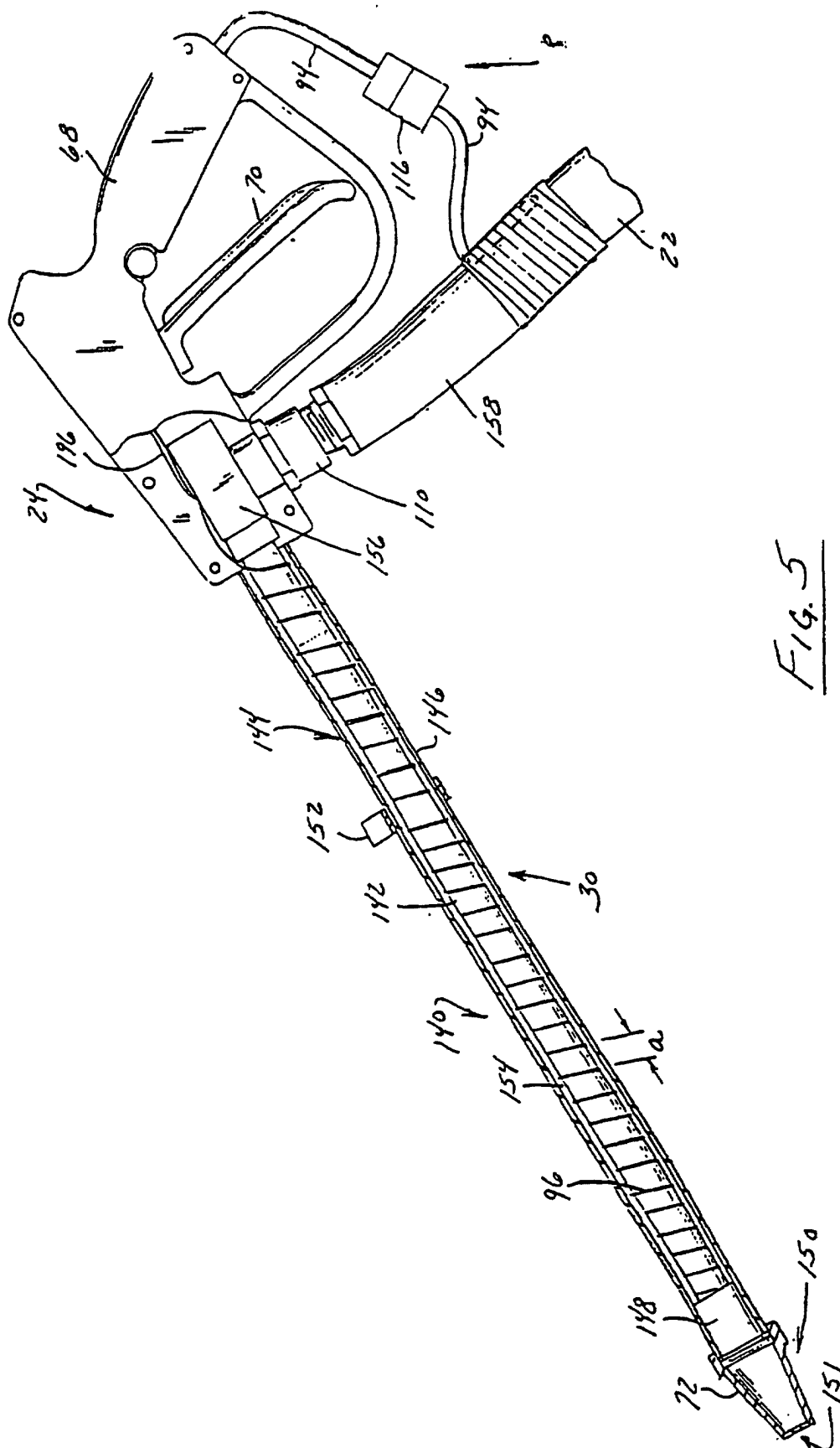


FIG. 4A



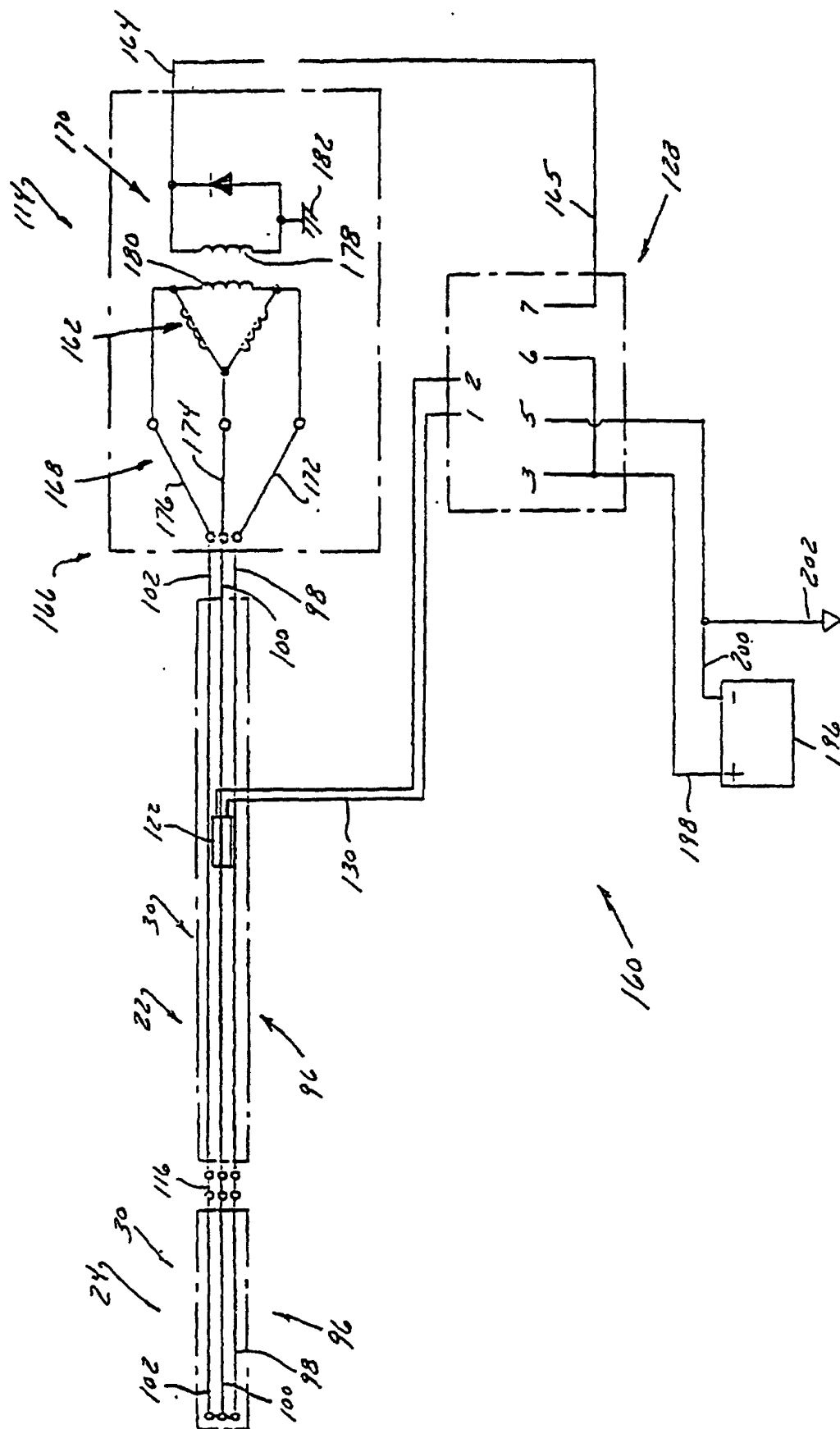


FIG. 6

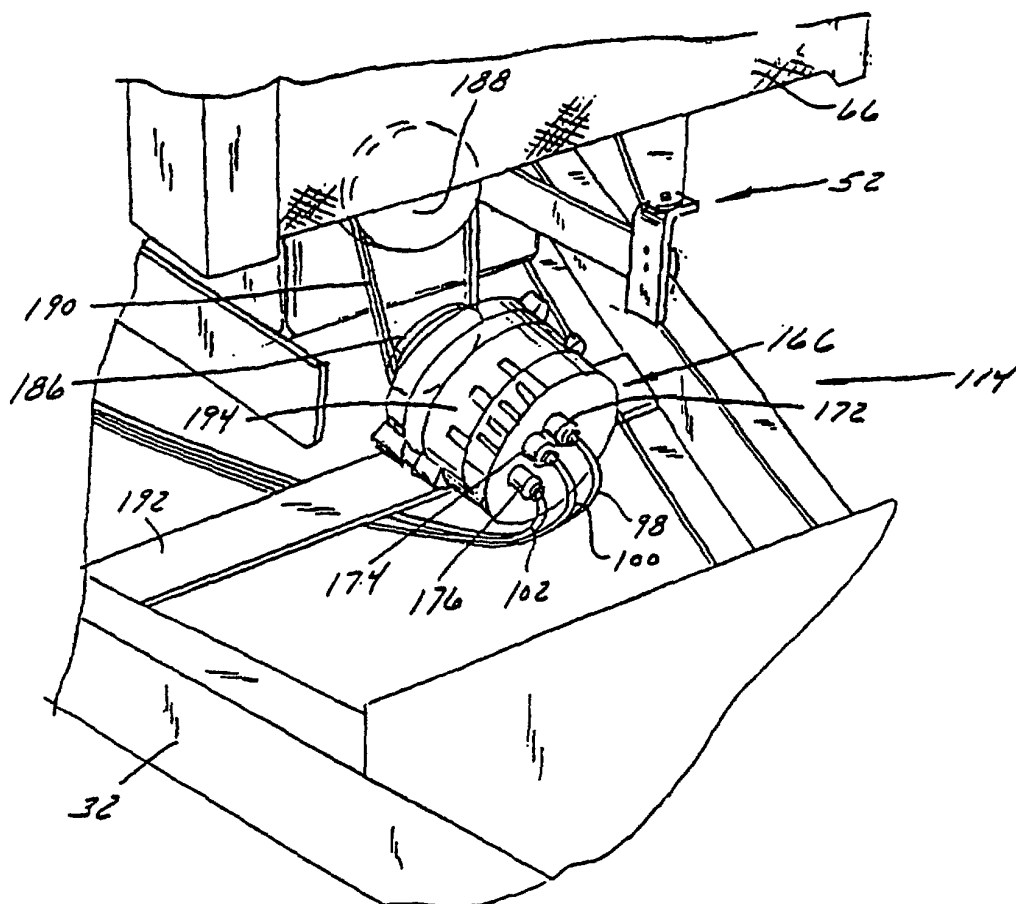


FIG. 7

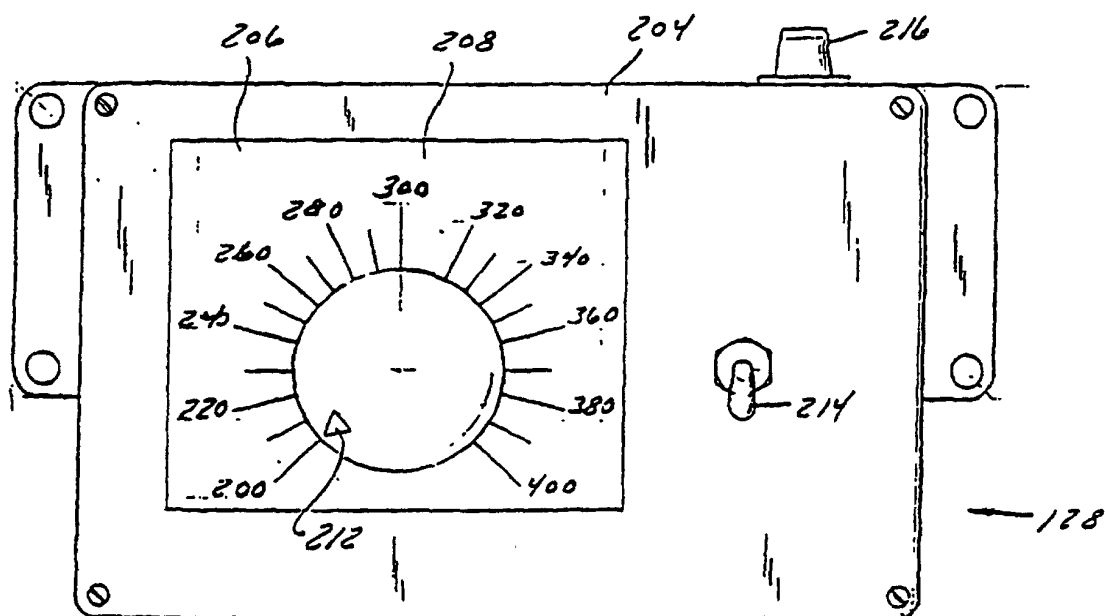


FIG. 8

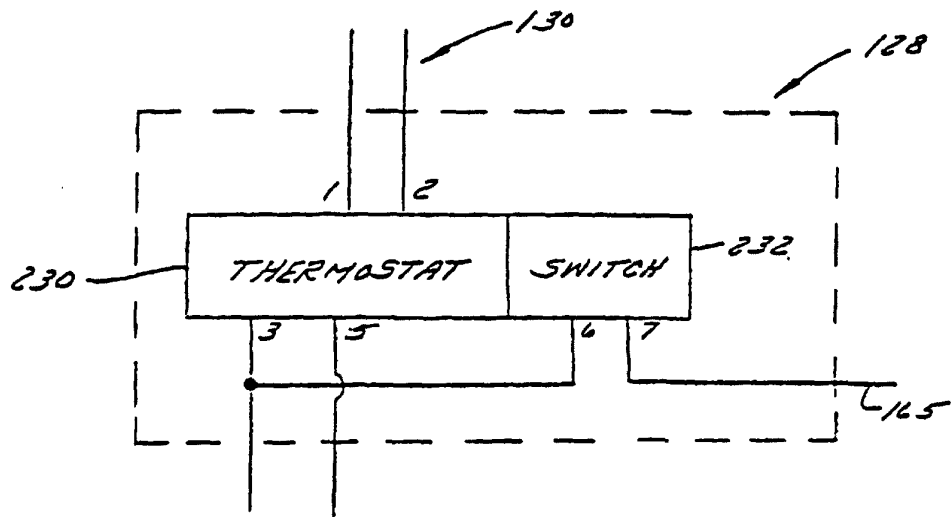


FIG. 6A

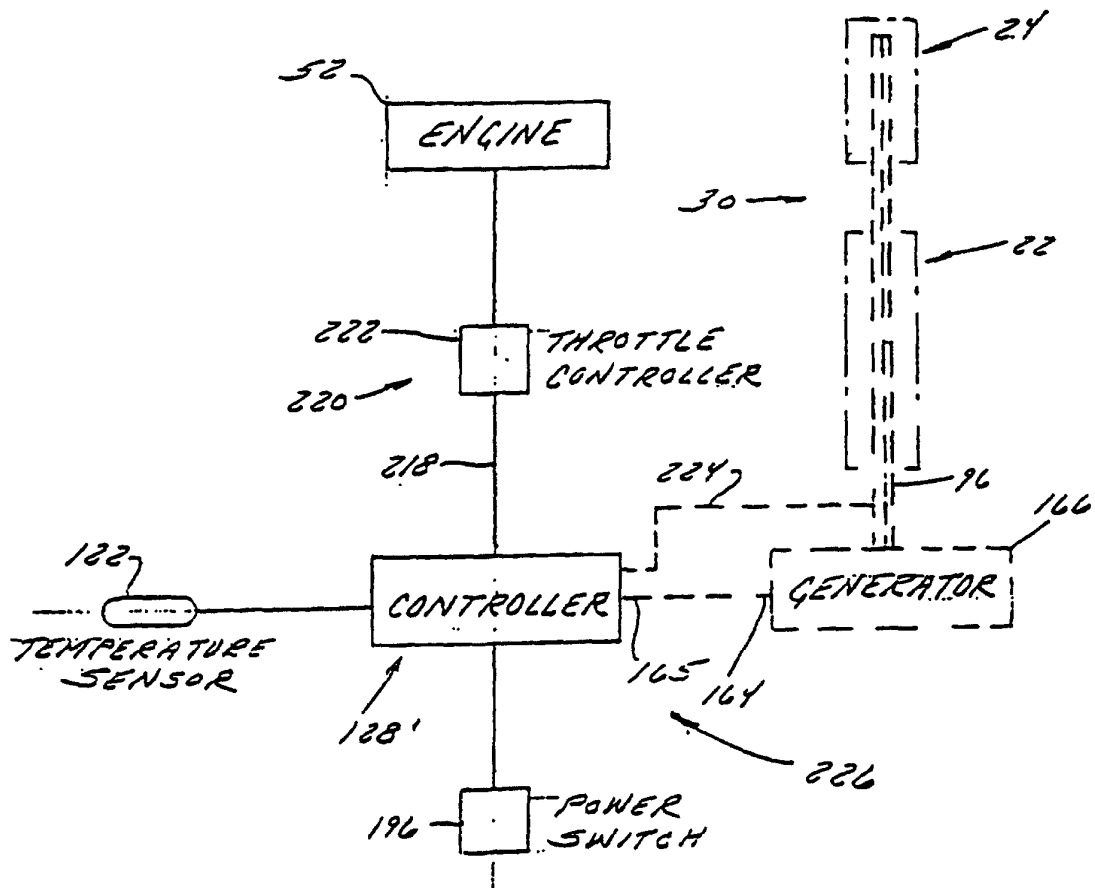
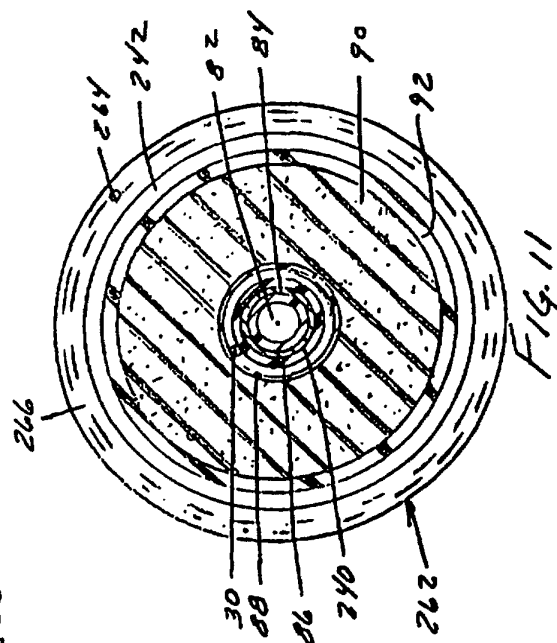
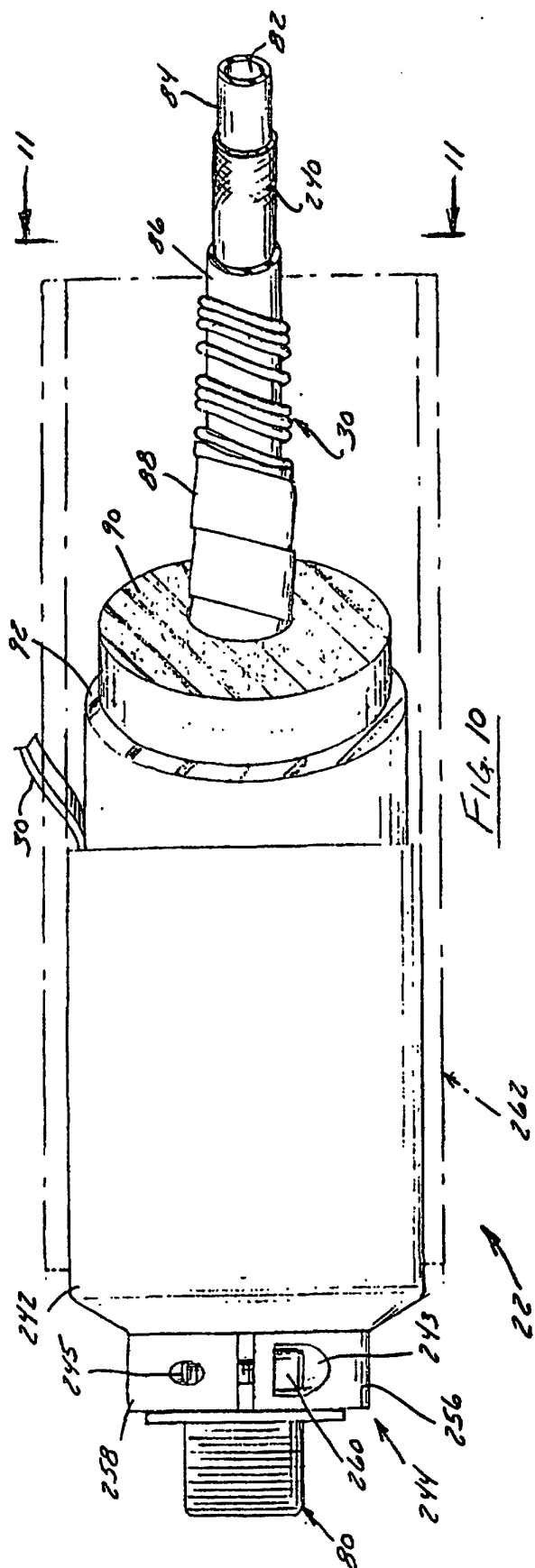


FIG. 9



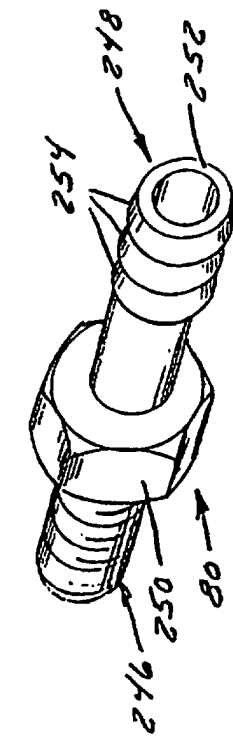


FIG. 14

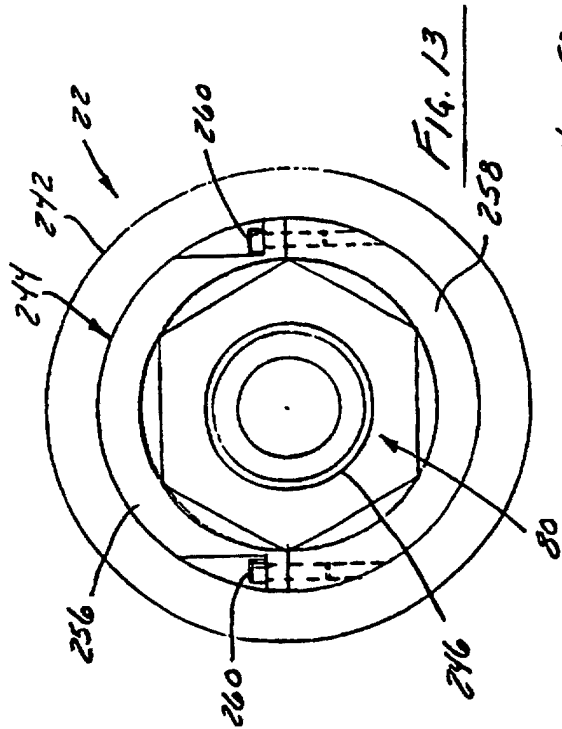


FIG. 13

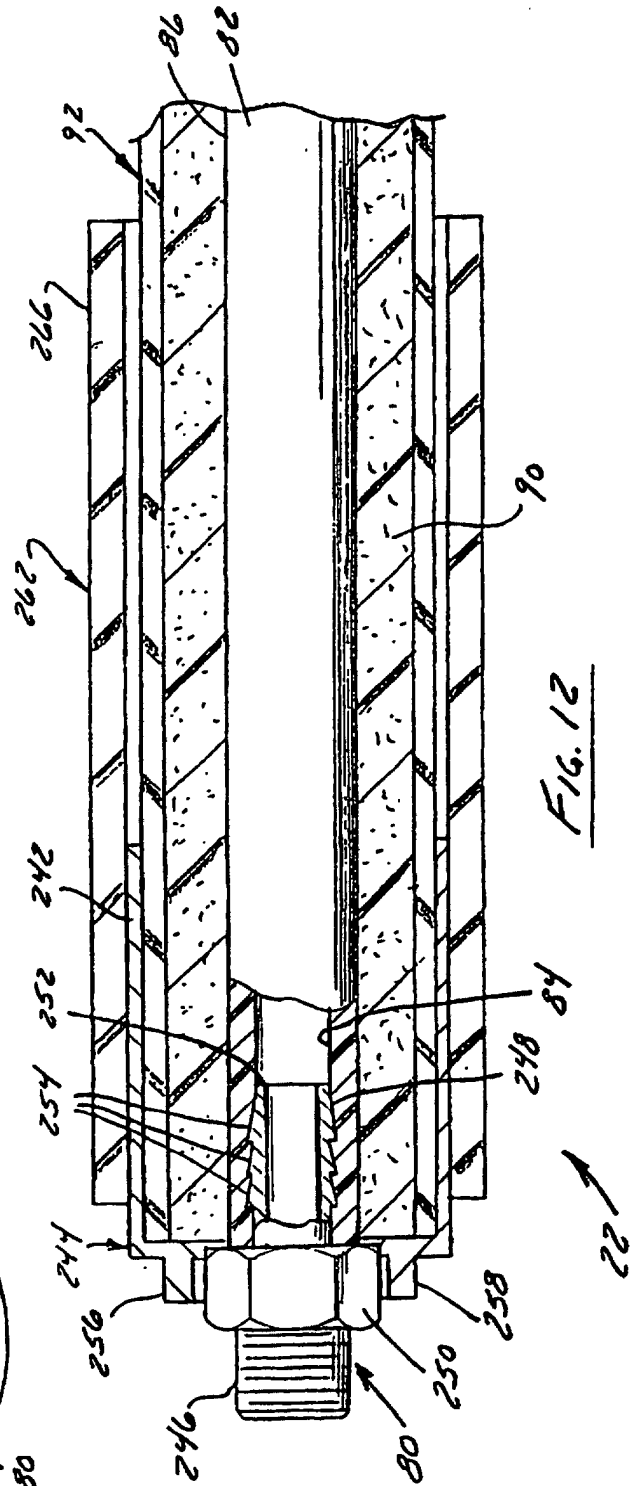


FIG. 12

