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(54) **Method and device for filling grooves and cracks in road surfaces**

(57) Method and apparatus (10) for filling Joints or cracks in road surfaces with hot bitumen (21) or rubberised bitumen. According to the method, heated air or

compressed air is utilised to keep a bitumen dosing tube (24) hot and/or to clean, dry and/or heat up a joint or a crack in the road surface prior to hot bitumen being dosed into it.

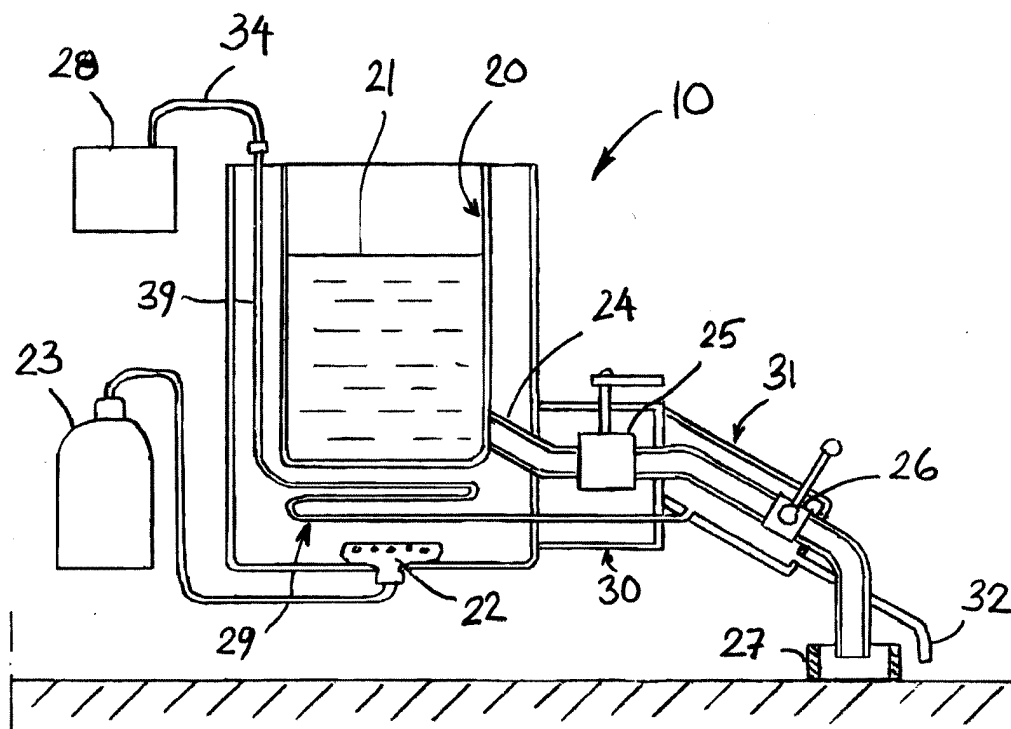


FIG. 1

Description

OBJECT OF THE INVENTION

[0001] The object of the present invention is a method for repairing and filling joints or cracks in the road surface of a driveway, such as a road or an airfield, using hot filler material, such as bitumen or rubberised bitumen, according to which method the bitumen contained in a bitumen tank is heated up by means of a heating apparatus, such as a gas burner, after which the hot bitumen in liquefied form is dosed into the joint or crack.

PRIOR ART

[0002] Joints and cracks in the road surfaces of driveways, such as roads or airfields, are repaired and filled according to the known method using hot filler materials, such as bitumen or rubberised bitumen. In such a procedure, a bitumen tank is brought to the repair site, and the bitumen is heated up in the tank using a heating apparatus, such as a gas burner. When the bitumen is sufficiently hot and liquefied, some of it, as much as a repair worker can carry by hand, is taken into a watering can equipped with a narrow spout. Subsequently hot bitumen in liquid form is poured and adequately dosed into the joint or crack so that it is filled in. It is obvious that such a method for repairing joints and cracks is slow and inefficient.

PURPOSE OF THE INVENTION

[0003] The purpose of this invention is to create a method that overcomes the above-mentioned drawbacks. A further purpose of the invention is to create an efficient and reliable method.

CHARACTERISTICS OF A METHOD ACCORDING TO THE INVENTION

[0004] A method according to the invention is characterized in that hot air or compressed air is utilised in the filling of joints or cracks in road surfaces in such a way that:

- the heated air or compressed air is conveyed into conjunction with a bitumen dosing tube to keep the dosing tube hot so that the bitumen contained in the dosing tube also remains sufficiently hot and liquefied, and/or
- the heated air or compressed air is conveyed into a joint or a crack in the road surface of a driveway, such as a road or an airfield, to clean and/or dry and/or heat it up prior to the hot bitumen being dosed into it.

[0005] The compressed air most advantageously used in the filling of a joint or a crack in the road surface is

heated by conveying the compressed air via the heating apparatus of the bitumen tank, whereby the compressed air is heated up simultaneously with the heating up of the bitumen tank.

[0006] The compressed air used in the filling of a joint or a crack in the road surface can be heated by means of a separate heating apparatus, such as a gas burner, located in conjunction with a heat exchanger in the air duct or compressed air duct, such as a tube coil, and the heated air or compressed air is conveyed via a nozzle into a joint or a crack in the road surface of a driveway, such as a road or an airfield, to clean and/or dry and/or heat it up prior to the hot bitumen being dosed into it

[0007] The compressed air used in the filling of a joint or a crack in the road surface is produced by means of an air compressor attached, for example, to the hydraulic system of a vehicle equipped with a bitumen tank, such as a tractor or a wheel loader.

APPARATUS ACCORDING TO THE INVENTION

[0008] The object of the invention furthermore is an apparatus for repairing and filling joints or cracks in the road surface of a driveway, such as a road or an airfield, using hot filler material, such as bitumen or rubberised bitumen, to be heated up in a bitumen tank located in conjunction with the apparatus or separately by means of a heating apparatus, such as a gas burner, so that the hot bitumen is in a liquefied form and can be dosed via a dosing tube of the bitumen tank into the joint or crack to be repaired and filled.

CHARACTERISTICS OF AN APPARATUS ACCORDING TO THE INVENTION

[0009] An apparatus according to the invention is characterized in that the apparatus is comprised of

- a fan or an apparatus for producing compressed air, such as an air compressor,
- a heating apparatus for the air or compressed air, such as a gas burner, via which the air or compressed air is conveyed to heat up the air or compressed air,
- an air duct or compressed air duct for conveying the heated compressed air into conjunction with a bitumen dosing tube to keep the dosing tube hot so that the bitumen contained in the dosing tube also remains sufficiently hot and liquefied, and/or
- an air duct or compressed air duct for conveying the heated air or compressed air via a nozzle into a joint or a crack in the road surface of a driveway, such as a road or an airfield, to clean and/or dry and/or heat it up prior to the hot bitumen being dosed into it.

[0010] An apparatus according to the invention can also be called a road surface repair apparatus because, especially at airports, road surfaces must be impervious

to prevent any antifreeze agents from leaking into groundwater. Using compressed air according to the invention makes the repair of road surfaces substantially more efficient.

[0011] The heating apparatus of the bitumen tank can also serve as a heating apparatus for compressed air in that a heat exchanger, such as a tube coil, has been arranged in the air duct or compressed air duct, the heat exchanger being located in conjunction with the heating apparatus of the bitumen tank, such as a gas burner.

[0012] The heating apparatus for compressed air can also be a separate heating apparatus, such as a gas burner, located in conjunction with a separate heat exchanger, such as a tube coil, located in an air duct or a compressed air duct. An apparatus according to the invention can also have two heat exchangers so that the air in an air duct or a compressed air duct is heated by means of the same heating apparatus that is used for heating the bitumen tank, and also by means of another heating apparatus in conjunction with the air duct or compressed air duct. The other heating apparatus is used to ensure that the air in the air duct or compressed air duct is always sufficiently hot even if the heating apparatus of the bitumen tank is not always operational.

[0013] A nozzle is most advantageously attached to the air duct or compressed air duct for conveying the heated air or compressed air into a joint or a crack in the road surface of a driveway, such as a road or an airfield, to clean and/or dry and/or heat it up prior to the hot bitumen being dosed into it.

[0014] The bitumen tank and its heating apparatus, such as a gas burner, is located on a vehicle, such as a tractor or a wheel loader, and a fan or an apparatus for producing compressed air, such as an air compressor, driven by the hydraulic system of the vehicle, is attached to the vehicle for producing a flow of air or compressed air.

[0015] The dosing tube of the bitumen tank may have a control valve controlling the dosing operation, and the cabin of the vehicle may have a control apparatus available for use to the vehicle operator, by means of which the operations of the control valve and thus the dosage of bitumen can be adjusted.

[0016] The cabin of the vehicle may also have a control apparatus at the operator's disposal, by means of which control apparatus the speed of the vehicle can be adjusted as low as required or to a constant speed when dosing bitumen into a joint in the road surface of a driveway, such as a road or an airfield.

[0017] In the following, the invention is described using examples with reference to the appended drawings, in which

LIST OF FIGURES

[0018]

Figure 1 shows a schematic side view of an apparatus according to the invention wherein hot com-

pressed air is used for filling a joint or a crack.

Figure 2 shows a schematic side view of another apparatus according to the invention wherein a vehicle serves as the apparatus using hot compressed air in the filling of a joint or a crack.

Figure 3 shows a schematic side view of a third apparatus according to the invention wherein hot compressed air is used for cleaning and heating a joint or a crack.

DESCRIPTION OF THE FIGURES

[0019] Fig. 1 shows a schematic side view of an apparatus 10 according to the invention comprising a bitumen tank 20 and bitumen 21 to be heated up therein. The bitumen heating apparatus is in the known manner a gas burner 22 to which gas is fed from a gas bottle 23. The hot bitumen 21 in liquefied form exits the bitumen tank 20 via a dosing tube 24 located in its bottom portion. A shut-off valve 25 and a control valve 26 are attached to the dosing tube 24. At the end of the dosing tube 24, there is an applicator foot 27 wherein the bitumen is allowed to enter. The dosed bitumen 21 does not spread out in the lateral direction but remains inside the applicator foot 27. When the applicator foot 27 is moved along a joint or a crack the bitumen adequately fills up the joint or crack to be filled.

[0020] According to the invention, hot compressed air is used efficiently in the apparatus 10 to help fill the joint or crack. The compressed air is conveyed from an air compressor 28 via a compressed air hose 34 into a compressed air tube 39 entering the apparatus 10. The air compressor 28 can also be replaced by a fan when compressed air is not necessary. The compressed air tube 39 forms a tube coil 29 under the bitumen tank 20, at the gas burner 22, which tube coil functions as a heat exchanger. While the bitumen 21 in the bitumen tank 20 is being heated by means of the gas burner 22 also the compressed air conveyed via the tube coil 29 becomes heated up. The hot compressed air is conveyed in the compressed air tube 39 further on through the casing 30 of the shut-off valve 25 into the casing 31 of the dosing tube 24. This ensures that the bitumen 21 entering the applicator foot 27 via the dosing tube 24 remains sufficiently hot and liquefied form even if the filling of the joint or crack takes place in cold conditions.

[0021] An advantageous method is such that the hot compressed air is not allowed to be wasted but is rather conveyed from the casing 31 of the dosing tube 24 to the nozzle 32 before the compressed air exits to the outside air. Thus the compressed air is directed via the nozzle 32 into the joint or crack to be filled to clean, dry and/or heat it up before dosing into it the bitumen 21 used as a filler. By cleaning, drying and/or heating the joint or crack beforehand, it is ensured that the concrete to be used for the fill will properly penetrate the joint or crack and also effectively adhere to it Fig. 1 does not specifically show the shape of the applicator foot 27 nor in which direction

the filling operation proceeds in the figure.

[0022] According to the invention, hot compressed air is used for heating the dosing tube and the valves attached thereto and/or for cleaning, drying and/or heating the joint or crack to be filled prior to filling and dosing of hot bitumen into the joint or crack. Both methods can be used jointly, as shown in Fig. 1, or separately, as shown below in Fig. 3.

[0023] Fig. 2 shows a schematic side view of an apparatus according to the invention wherein a vehicle 33 serves as the apparatus 10 using hot compressed air in the filling of a joint or a crack. As seen in Fig. 2, a bitumen tank 20 is located in the front portion of the vehicle 33, a wheel loader. A gas bottle 23 is located next to the bitumen tank 20 for the gas burner. An air compressor 28 is located in the rear portion of the wheel loader, wherein it is attached to the hydraulic system of the vehicle 33. As the work machine has an integrated hydraulic system, it is advantageous to use attachments, such as the air compressor 28 in this case, by means of the hydraulic system. A pneumatic hose 34 has been conducted to the front part of the vehicle, in conjunction with the bitumen tank 20.

[0024] Fig. 2 also shows that the operator of the vehicle 33 has good visibility to the joint or crack to be filled and to the applicator foot 27 dosing bitumen 21. In Fig. 2, the applicator foot 27 is depicted so that it is in front of the vehicle 33 and the bitumen tank 20. In practice, however, it is advantageous to locate the dosing tube and applicator foot 27 slightly to the side, whereby it is closer to the operator of the vehicle 33 and even better in his or her field of vision. Yet another excellent detail of the invention is that the operator of the vehicle 33 has a control apparatus in the cabin, by means of which he or she can adjust the control valve of the dosing tube. This makes the filling of the joint or crack very efficient. Fig. 2 shows a control cable 35 as an example of the control apparatus moving the lever 36 of the control valve.

[0025] Fig. 3 shows a schematic side view of an apparatus according to the invention wherein hot compressed air is used to clean, dry and/or heat a joint or crack. The apparatus has a coil 29 of a compressed air tube located in a hand cart, which coil is heated by means of a gas burner 22 located in the bottom portion of the apparatus and directed upwards. Hot exhaust gases are directed away from the user of the apparatus by means of a tube 37. The hot heating compartment 38 can be guarded by mesh or a grille not shown in Fig. 3. The compressed air exits via a nozzle 32 so that the hot blast of compressed air is directed into the joint or crack to be filled.

ADDITIONAL NOTES

[0026] It is obvious to a person skilled in the art that the different embodiments of the invention may vary within the scope of the claims presented below.

LIST OF REFERENCE NUMBERS

[0027]

5	10	Apparatus
	20	Bitumen tank
	21	Bitumen
	22	Gas burner
	23	Gas bottle
10	24	Dosing tube
	25	Shut-off valve
	26	Control valve
	27	Applicator foot
	28	Air compressor
15	29	Tube coil
	30	Casing of the shut-off valve
	31	Casing of the dosing tube
	32	Nozzle
	33	Vehicle
20	34	Pneumatic hose
	35	Control cable
	36	Lever
	37	Tube
	38	Heating compartment

Claims

1. A method for repairing and filling joints or cracks in the road surface of a driveway, such as a road or an airfield, using hot filler material, such as bitumen (21) or rubberised bitumen, according to which method the bitumen contained in a bitumen tank (21) is heated up by means of a heating apparatus, such as a gas burner (22), after which the hot bitumen in liquefied form is dosed into the joint or crack, **characterized in that** hot air or compressed air is utilised in the filling of joints or cracks in road surfaces such that:
 - the heated air or compressed air is conveyed into conjunction with a bitumen (21) dosing tube (24) to keep the dosing tube hot, so that the bitumen contained in the dosing tube also remains sufficiently hot and liquefied, and/or
 - the heated air or compressed air is conveyed into a joint or a crack in the road surface of a driveway, such as a road or an airfield, to clean and/or dry and/or heat it up prior to dosing the hot bitumen (21) into it.
2. A method according to claim 1, **characterized in that** the compressed air used in the filling of a joint or a crack in the road surface is heated by conveying the compressed air via the heating apparatus of the bitumen tank (20), whereby the compressed air is heated up simultaneously with the heating up of the bitumen tank.

3. A method according to claim 1, **characterized in that**

- the compressed air used in the filling of a joint or a crack in the road surface is heated by means of a separate heating apparatus, such as a gas burner (22), located in conjunction with a heat exchanger in the air duct or compressed air duct, such as a tube coil (29), and
- the heated compressed air is conveyed via a nozzle (32) into a joint or a crack in the road surface of a driveway, such as a road or an airfield, to clean, dry and/or heat it up prior to dosing hot bitumen (21) therein.

4. A method according to any one of claims 1, 2 or 3, **characterized in that** the compressed air used in the filling of a joint or a crack in the road surface is produced by means of an air compressor (28) attached to the hydraulic system of a vehicle (33) equipped with a bitumen tank (20), such as a tractor or a wheel loader.

5. An apparatus (10) for repairing and filling joints or cracks in the road surface of a driveway, such as a road or an airfield, using hot filler material, such as bitumen (21) or rubberised bitumen, to be heated up in a bitumen tank (20) in conjunction with the apparatus or in a separate bitumen tank (20) by means of a heating apparatus, such as a gas burner (22), so that the hot bitumen is in a liquefied form and can be dosed via a dosing tube (24) of the bitumen tank into the joint or crack to be repaired and filled, **characterized in that** the apparatus (10) comprises:

- a fan or an apparatus for producing compressed air, such as an air compressor (28),
- a heating apparatus for the air or compressed air, such as a gas burner (22), via which the air or compressed air is conveyed to heat up the air or compressed air,
- an air duct or compressed air duct for conveying the heated compressed air into conjunction with the dosing tube (24) of bitumen (21) to keep the dosing tube hot so that the bitumen contained in the dosing tube also remains sufficiently hot and liquefied, and/or
- an air duct or compressed air duct for conveying the heated air or compressed air via a nozzle (32) into a joint or a crack in the road surface of a driveway, such as a road or an airfield, to clean and/or dry and/or heat it up prior to hot bitumen (21) being dosed into it.

6. An apparatus (10) according to claim 5, **characterized in that** the heating apparatus of the bitumen tank (20) is simultaneously a heating apparatus for compressed air **in that** a heat exchanger, such as a

tube coil (29), has been arranged in the air duct or compressed air duct, the heat exchanger being located in conjunction with the heating apparatus of the bitumen tank, such as a gas burner (22).

7. An apparatus (10) according to claim 5, **characterized in that**

- the heating apparatus of the air duct or compressed air is a separate heating apparatus, such as a gas burner (22), located in conjunction with a heat exchanger, such as a tube coil (29), located in the air duct or the compressed air duct, and
- the separate heating apparatus of the air duct or compressed air can operate alone or simultaneously with the heating apparatus of the bitumen tank (20).

8. An apparatus (10) according to any one of claims 5, 6 or 7 **characterized in that**

- the bitumen tank (20) and its heating apparatus, such as a gas burner (22), are located on a vehicle (33), such as a tractor or a wheel loader, and
- an apparatus for producing compressed air, such as an air compressor (28), driven by the hydraulic system of the vehicle, is attached to the vehicle (33).

9. An apparatus (10) according to any one of claims 5 to 8, **characterized in that** the dosing tube (24) of the bitumen tank (20) has a control valve (26) controlling the dosing operation, and the cabin of the vehicle has a control apparatus available for use by the vehicle operator, by means of which control apparatus the operation of the control valve and thus the dosage of bitumen (21) can be adjusted.

10. An apparatus (10) according to any one of claims 5 to 9, **characterized in that** the cabin of the vehicle (33) has a control apparatus at the operator's disposal, by means of which control apparatus the speed of the vehicle can be adjusted as low as required or to a constant speed when dosing bitumen (21) into a joint in the road surface of a driveway, such as a road or an airfield.

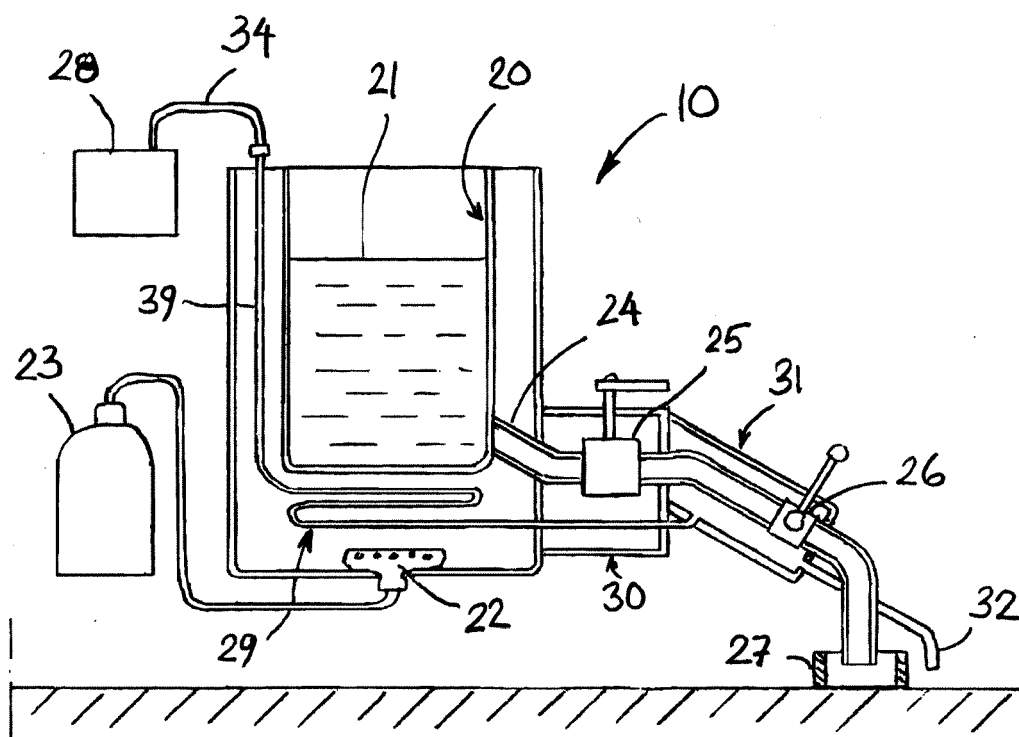
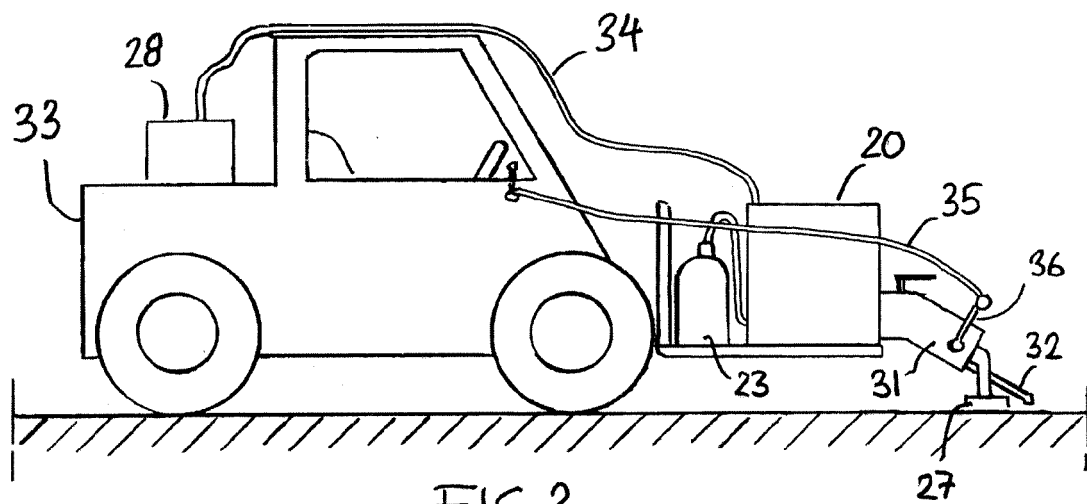


FIG. 1



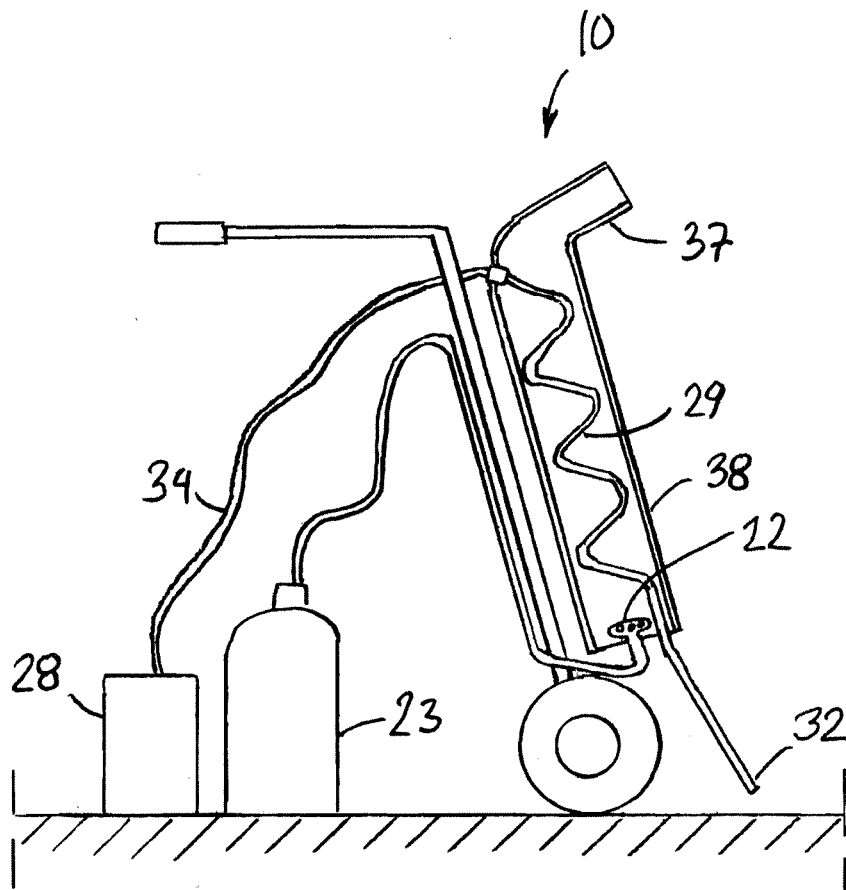


FIG. 3