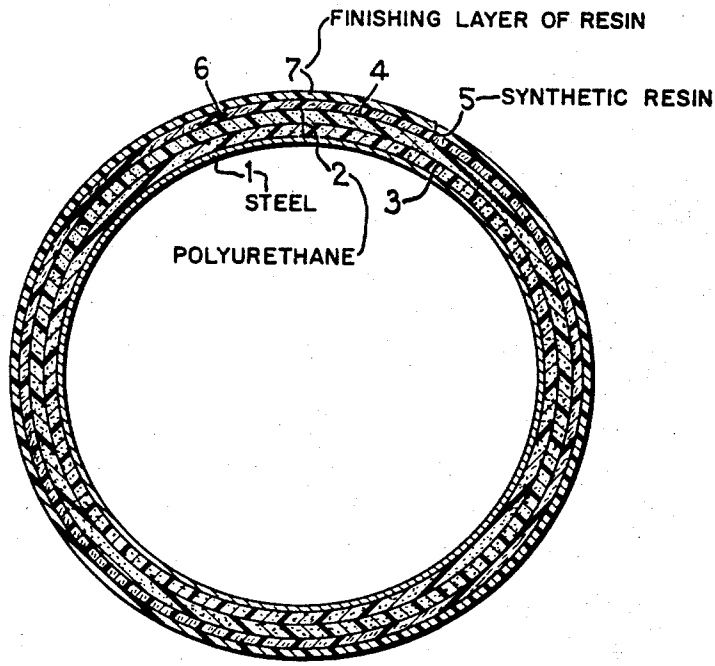
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HEAT-INSULATED CONDUIT OF UTILITY IN THE TRANSPORT OF FUELS OVER LONG DISTANCES

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HEAT-INSULATED CONDUIT OF UTILITY IN THE TRANSPORT OF FUELS OVER LONG DISTANCES

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ABSTRACT OF THE DISCLOSURE

Heat-insulated pipe of utility in the transport over a long distance of viscous products and in particular fuels, comprising a metal tube, a lagging of rigid foam polyurethane adhering to the tube and a resinous coating encompassing the lagging.

The present invention relates to a new type of buried pipe of utility in the transport over a long distance of viscous products which must be heated in order to be conveyed. It is more particularly concerned with the transport of heavy fuels.

It is known that, for reasons of facilities of supply, it is of interest to locate oil refineries on the seacoast.

The finished products, such as gasoline, gas oil, light fuel, can be easily conveyed by pipelines. The problem arises in respect of heavy fuel which, owing to its viscosity, can only be transported at a temperature between 40 and 80° C.

This fuel, which must supply factories consuming large amounts of energy located far from seacoasts, such as steam generating stations, steel works, has been conveyed heretofore in barges, trucks or wagons which are a much more costly means of transport than pipelines. The advantage to be gained in employing a heat-insulated pipeline for transporting this heavy fuel is thus evident.

The object of the present invention is to provide a solution to this problem which has not yet been solved.

Methods of laying ordinary pipelines are well known and employ a large amount of equipment. The underlying principle is the following:

A trench is dug in the ground. Pipe sections placed along side this trench are electrically welded; the pipe thus obtained is taken up by machines on articulated tracks (said machines are known as side-brooms) which raise them off the ground; a machine specially designed for this work prepares the surfaces, applies the hooking or binding layer, coats the pipe with a thick protective coating containing blown coal tar or bitumen, and protects this layer with a glass fabric.

All these operations are carried out in a continuous manner at the rate of 5–10 metres per minute.

The pipe thus prepared is thereafter placed on the bottom of the trench and then covered with earth.

It will be understood that these operations employ a considerable amount of equipment and do not lend themselves well to the heat insulation or lagging of the pipe by conventional means, such as with prefabricated shells or the like, which are fragile and do not support very well such handling.

The object of the present invention is to provide a heat insulating pipe which lends itself to the transport of fuel and like viscous products and is capable of being laid by the same means as those previously employed for

conventional pipelines transporting low-viscosity light products at surrounding temperature.

A further object of the invetnion is to provide such a pipe which can be electrically insulated in a perfect manner irrespective of the dampness of the ground thereby permitting both a catholic protection and possible electric heating.

For this purpose, according to the invention, the heat insulation comprises a layer of rigid foam polyurethane having a thickness of preferably 2–5 cm. which is sprayed directly onto the metal pipe which is usually of steel. The sprayed polyurethane swells within a few tens of seconds—10–60 seconds—and provides a foam having closed cells. The spraying can be carried out in one or two layers in accordance with the required thickness. Each layer provides a thickness of about 2 cm. The spraying of the second layer can be carried out 5–30 seconds after the first.

This foam polyurethane adhering to the pipe both heat insulates and electrically insulates the latter and thus provides a cathodic protection. The pipe is thus coated with a rigid casing of foam polyurethane adhering to the metal.

The foam polyurethanes employed in accordance with the invention are those resulting from the conventional combination of a reactive polyisocyanate $R(N=C=O)n$, R being hydrocarbonated radical and n a whole number equal to or exceeding 2 with a component including reactive hydrogens in the presence of a foaming agent constituted by a compound of high volatility.

By way of compounds including reactive hydrogens there may be mentioned polyesters manufactured from diacids and polyalcohols, polyethers and castor oil. It must be understood, however, that the invention is not intended to be limited by this list.

However, the polyesters are preferred since they provide foams which are more resistant to compression. For the purpose of the invention preference is given to foam polyurethanes having a density of between 25 and 60 kg/cu. m. and a heat transmission coefficient λ of less than 0.03. The lower limit of the density depends on the required crush-resistance of the foam, the upper limit on cost price.

According to the invention, the following method is employed for placing the foam polyurethane form heat insulating lagging or casing around the pipe.

Spray guns are fed with relative metered amounts of constitutents producing by their reaction a polyurethane, these constituents being fed separately to the guns and one of them containing a swelling agent. The reaction mixture thus formed is sprayed onto the pipe by these guns.

Two groups of guns are preferably employed one of which is for spraying the first layer and the other the second. These guns can be arranged as a ring around the pipe. By way of a variant, the pipe is rotated and in this case the number of guns can be reduced.

This method can be improved by the prior heating of the pipe by any means, for example burners, this heating being intended to activate the start of the polymerization reaction. This method of operating results in a more rapid hardening of the foam and is advantageous but not essential.

The polyurethane can be sprayed onto the bare pipe or onto a pipe already covered with a varnish. In either case a polyurethane coating or lagging firmly adhering to the pipe is obtained.

This lagging is often in itself sufficiently strong (and this is one of the advantages of the invention) for supporting the weight of the pipe and of the substance in the pipe without crushing and therefore without loss of its

heat insulating properties. However, it is of interest to protect this lagging so as to avoid any risk of crushing. For this purpose, there may be employed: a bituminous or tarry cement poured into the trench after the heat-insulated pipe has been laid therein; a spraying of a conventional product containing blown bitumen or coal tar; adhesive bands such as those employed in the conventional lagging of normal pipelines.

However, it has been discovered according to the invention that the protection of the foam polyurehane lagging is insured in the most effective manner by a stratified or laminated coating of solid synthetic resin.

By solid resin is meant in the present description a resin which is not in the form of a foam as opposed to the polyurethane lagging.

The resin of the protective coating can be polyurethane, an epoxy resin or like resin. However, particularly good results are obtained with polyester resins which are thus preferred, particularly because of their low cost price.

Whatever type of resin is employed, the protective coating is applied in the same way as the polyurethane case or lagging by spraying with spray guns.

The thickness of the protective coating is usually 2–4 mm. and it contains 20–40% by weight of fibres, for example glass fibres, as stratification material.

This protective coating is advantageously deposited in successive layers.

The single figure of the accompanying drawing shows in a diagrammatic manner merely by way of illustration the cross-section of a heat-insulated and protected conduit according to the invenion.

In this figure some thicknesses have been exaggerated for reasons of clarity. The figure shows the steel tube **1** surrounded by a casing or lagging **2** of foam polyurethane having a thickness of about 2–5 cm. and sprayed directly onto the tube. This foam has a density of 25–60 kg./cu. m., and preferably 30–45 kg./cu. m. Its heat transmission coefficient λ is less than 0.03 and generally in the neighbourhood of 0.02.

The spraying of the casing or lagging **2** is advantageously effected in two layers in respect of the thickest lagging of the order of 5 cm. This results in two skins **3** and **4** constituting the outer face of each of the layers. These skins constitute a more effective barrier to the spreading of dampness than the mass of polyurethane itself. If the first skin is damaged by handling, there still remains the second skin which is most likely to remain intact since it is located 2–3 cm. within the lagging.

The lagging **2** is provided with a coating **5** affording a protection from blows and dampness. This coating **5** has a thickness of about 2–4 mm. and is composed of a solid and stratified or laminated synthetic resin, such as a polyurethane resin, an epoxy resin or, better still, a polyester, the stratification material being constituted by fibres and in particular glass fibres. The consitution of these various resins is sufficiently well known and no description thereof is needed in the present description.

The coating **5** is sprayed directly onto the lagging **2**. As for the latter, it is advantageous to operate in successive layers. A first layer—not shown in the drawing owing to its extremely small thickness—is a hooking or binding layer composed of resin without fibres. A second layer **6** constituting the essential part of the coating is composed of resin containing such percentage of fibres that the coating **5** contains 20–40% by weight thereof. A third layer **7**, or finishing layer, covers the layer **6** and has a thickness of about ⅓ or ¼ of the thickness of the layer **6**.

To give a further illustration of the invention, an example of the preparation of the casing or lagging **2** and its protective coating **5** will now be given.

The foam polyurethane constituting the lagging **2** is formed by the mixture of two constituents fed to spray guns in appropriate proportions by metering pumps.

These two constituents have the following composition, partly by weight.

The first constituent:	
Desmophen SWD	100
Freon II	25
Desmorapid PP	4
The second constituent:	
Desmodur 44 V	110

Desmophen SWD, Desmorapid PP and Desmodur 44 V are commercially avaliable products manufactured by Bayer and affiliated firms. The first is a product containing reactive hydrogens (in the present case of a mixture of polyether and polyester), the second an accelerator (a tertiary amine) and the third a polyisocyanate (methyl-diphenyl diisocyanate).

Freon is the foaming agent producing a foam polyurethane having closed cells. The foam obtained has a density in the neighbourhood of 38 kg./cu. m., a resistance to compression after 30 seconds of 1 kg./sq. cm. and a heat transmission coefficient λ of 0.02.

To form the protective coating **5**, three successive layers are then sprayed onto the lagging **2**, namely:

(1) A fibreless hooking or binding layer of 50–100 g./sq. m.

(2) A fibrous layer containing 30% glass fibres of about 2,400 g./sq. m.

(3) A fibreless finishing layer of about 800 g./sq. m.

The finishing layer is applied after the fibrous mass has been slightly rolled with a foam roller in accordance with the conventional method of applying stratified or laminated layers.

To form the binding layer and the fibrous layer, there is employed as the resin a polyester formed for example by a mixture of the following commercially available products:

	Parts by weight
Stratyl A 750	50
Stratyl A 710	50

Strayl A 750 and Stratyl A 710 are polyesters manufactured by the Pechiney Company, the first containing a maleic acid, isophthalic acid and diethylene glycol, the second containing the same acids and propylene glycol.

Added to this mixture of polyesters are 2% by weight of methylethylketone peroxide as the catalyst, and 0.2% by weight of cobalt naphthenate as the accelerator.

The gelling of the layers thus deposited is obtained within about 1 hour and their polymerization within less than 2 hours.

As concerns the finishing coating, there is preferably employed as the polyester Stratyl W having a composition similar to that of the aforementioned products but containing in addition a small amount of paraffin which ensures a more rapid polymerization of the surface and consequently reduces the time at the end of which the foam polyester ceases to be sticky. The polymerization can be still further accelerated by passing the conduit elements thus coated through a tunnel heated to 50–60° C. so as to obtain a good strength of the coating in less than 1 hour.

The foam polyurethane casing or lagging **2** and the coating **5** extend over the entire length of each conduit element except at each end over a length of 15–40 cm. which is left bare to permit welding the element to the adjacent element. After welding, the bare part of each element is treated as before so as to provide it with a lagging **2** and a coating **5** which naturally merge with the corresponding previously-applied deposits. This is moreover one of the great advantages of the invention, namely the possibility of obtaining a heat insulation and a homogeneous protection over the entire length of the pipe and including the joints, which constituted the weak points of the protections according to prior methods.

The sealing qualities and the strength of the protection of the pipe elements according to the foregoing example have been tested. It has been found that after 15 days of immersion both in an acid water having a pH of 1 and in an alkaline water having a pH of 12, the electrical resistance between the metal part of the conduit and the insulating lagging remains constant at a value exceeding 10^{11} ohms. This indicates the excellent protection.

Although specific embodiments of the invention have been described, many modifications and changes may be made therein without departing from the scope of the invention as defined in the appended claims.

Having now described my invention what I claim as new and desire to secure by Letters Patent is:

1. Heat insulated pipe of utility in the transport over a long distance of viscous products and in particular fuels, comprising a metal tube, a lagging of rigid foam polyurethane having closed cells and encompassing and adhering to the tube, said foam polyurethane having a density of about 25–60 kg./cu. m. and a heat transmission coefficient of less than 0.03 and a resinous coating protecting the lagging from shocks.

2. Pipe as claimed in claim 1, wherein the lagging has a thickness of about 2–5 cm.

3. Pipe as claimed in claim 1, comprising a layer of varnish between the tube and the lagging.

4. Heat-insulated pipe of utility in the transport over a long distance of viscous products and in particular fuels, comprising a metal tube, a lagging of rigid foam polyurethane having closed cells and encompassing and adhering to the tube, said foam polyurethane having a density of about 25–60 kg./cu. m., and a heat transmission coefficient of less than 0.03 and a stratified coating of solid resin encompassing said lagging and protecting it from shocks.

5. Heat-insulated pipe of utility in the transport over a long distance of viscous products and in particular fuels, comprising a metal tube, a lagging of rigid foam polyurethane having closed cells and encompassing and adhering to the tube, said foam polyurethane having a density of about 25–60 kg./cu. m., and a heat transmission coefficient of less than 0.03, and a thickness of about 2–5 cm., and a stratified coating having a thickness of about 2–4 mm. and composed of solid polyester resin encompassing the lagging and protecting it from shocks.

6. Pipe as claimed in claim 5, wherein the stratified coating contains 20–40% by weight of fibres.

7. Pipe as claimed in claim 5, wherein the stratified coating is composed of three successive layers, namely a thin fibreless binding layer of resin deposited in contact with the lagging, a layer of resin containing fibres and constituting the major part of the stratified coating and a layer of fibreless resin having a thickness of between about ⅓ and ¼ of the thickness of the preceding layer.

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