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LINING OF IRON AND STEEL PIPES AND TUBES.

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This invention relates to the lining of iron and steel pipes and tubes with a bituminous composition.

It is well known, in the art, that certain bituminous substances, such as asphalt, (natural or artificial) are waterproof and also capable of resisting the action of acids and alkalis and that they possess valuable insulating qualities. They are, therefore, very desirable materials for coating or lining pipes intended for the conveyance of liquids. One drawback, in connection with their use, is that they may have a comparatively low melting point, which varies according to the material and grade. Another drawback is that, while some of them are brittle solids at normal temperatures in Britain, they easily become plastic under the action of heat such as sometimes prevails in hot climates.

It has been found that iron and steel pipes and tubes (hereinafter referred to as "tubes") lined with tar or the like, when shipped abroad, have become bound together in the ship's hold owing to the tar running down the tubes in the close hot atmosphere, with the result that it has been very difficult subsequently to remove the tubes from the hold and that they have frequently bent during such removal.

It is common practice to line and coat such tubes with tar or with bituminous compositions (in some cases consisting of loading materials having pitch or bitumen as a binding agent) by a dipping process but the lining in such cases is thin, lacks uniformity throughout the tubes and is liable to run or creep in hot climates or under hot conditions, and consequently tubes, so lined, cannot be relied on for all general purposes. In some cases, it has been proposed first to coat flat sheet metal with asphalt, or the like, and then roll the said sheet metal into cylindrical shape to form the tube but the cost of such procedure is prohibitive, whilst, in other cases it has been proposed to line metal, cement, and other pipes with bituminous and other materials by centrifugal action and under heat.

The object of this invention is to line or coat uniformly the interior surface of iron and steel tubes with a bituminous composition of such a nature and consistency that whilst it will adhere closely and tenaciously to the tube and will withstand sudden shocks it will also be able to resist a temperature above the ordinary melting point of the bituminous substance in the composition before starting to creep or flow in the tube.

Under this invention the bituminous substance, preferably ordinary commercial asphalt, is heated and while in the liquid state, is thickened, by the incorporation or admixture therewith of a suitable loading material (capable of realizing the object aforesaid such as, silica flour, slaked lime or kieselguhr in a fine condition) until the mass assumes a semi-liquid condition and, in this condition, it is introduced into the interior of the iron or steel tube, which is also heated, and is then evenly distributed over the inner surface of the tube by rapidly rotating the same by means of suitable mechanism. The hot composition is distributed in known manner, by centrifugal force uniformly over the inner surface of the heated tube, and, when cold, it forms an inner lining or coating which adheres closely and tenaciously to the tube and also presents a smooth inner surface. The lining may be made of any desired thickness.

It is important that the loading material be thoroughly intermixed with the asphalt so as to give a lining of uniform density throughout and must remain so intermixed and, to this end, the loading material must have such physical properties, being porous and absorbent, that under the action of centrifugal force, it will not tend to separate out from the asphalt and accumulate either towards the inside or the outside of the lining. The loading material being of a porous nature is penetrated by the asphalt and thereby held against free movement.

By the term "loading" material I mean a material which can be readily spread through the liquid bituminous substance and become so thoroughly incorporated or admixed therewith as to charge or load the same throughout.

In order to produce an effective lining capable of withstanding all likely temperature to which water or other liquid conveying tubes may be exposed, I have conducted numerous experiments and have tried various bituminous compositions and I have been put to considerable expense in so doing.

I will now proceed to describe, by way of example, one way of carrying out the invention.

Asphalt is heated to liquefaction when it is thickened and stiffened with a loading material of the same or substantially the same specific gravity as the asphalt, preferably silica flour, slaked lime, or kieselguhr in a very finely divided state, until the whole assumes a semi-liquid condition and, in this condition, the composition, while hot, is charged or led into the tube to be lined. The tube, which is also heated, preferably by gas jets, is mounted in a suitable turning machine, such as a large lathe, whereby it may be rotated at a fairly high speed so that, when the composition is within the tube, it will be evenly distributed as a lining throughout the tube by the action of centrifugal force the nature of the composition being such that the loading material, under the centrifugal action, will not separate out from the asphalt and accumulate either to the inside or the outside of the lining. The lined tube is then allowed to cool or is cooled while rotating, by a water spray until the lining hardens. The loading material used increases the heat resisting qualities of the bituminous substance.

In carrying out my process when treating a tube say two feet diameter and twenty feet long I prefer to mount the same in a lathe or similar machine suitable for revolving the tube. Below the tube I arrange a long pipe through which water-gas passes and issues as jets which play upon the tube and heat it whilst rotating.

The tube, before entering the composition, is heated uniformly to about 300° F. The flash point of asphalt is about 480° F., and the bituminous composition is heated to a temperature of about 420° F. so as to keep it sufficiently liquid readily to flow into the tube. The temperature should be kept below the flash point of the asphalt, and the asphalt itself, to give the best results, should have a melting temperature (ball and ring test) of about 160° F.

While the heated composition is being conducted into the interior of the the tube, the tube is rotated slowly by hand, or otherwise, but, after all the composition has been introduced and has spread throughout the length of the tube, it is rotated very rapidly by power from a motor or engine until a peripheral speed from about 20 to 50 feet per second is reached.

The ends of the tube have rings fitted therein to retain the charge after being introduced.

The rapid rotation of the tube causes the composition, under centrifugal action, to line the tube uniformly throughout its length, and to a thickness in conformity with the amount of composition introduced. Thereafter the tube is cooled, while rotating, preferably by water jets from an overhead pipe or pipes.

A tube lined in this way has a clean smooth surface and while the lining adheres most tenaciously and closely it is capable of resisting a temperature above the ordinary melting point of the asphalt before starting wholly or partially to creep or flow in the tube, this being a most important factor from a commercial point of view.

I find kieselguhr to give very good results as it is both light and porous and it absorbs the asphalt in its cellular structure. Slaked lime and silica flour have also given good results.

When kieselguhr is used I prefer to mix the ingredients in the proportions of:—

Asphalt (Texaco)	100
Kieselguhr	68.5

With slaked lime I have used:—

Asphalt (Texaco)	100
Slaked lime (powdered)	83.3

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

1. A process of lining the interior surface of iron and steel tubes, consisting in heating a bituminous substance until in liquid form, mixing therewith a loading material of such physical properties that it will not separate from the bituminous substance under centrifugal action on the mass, heating the tube, introducing the molten loaded bituminous substance into the heated tube, and distributing such substance over the interior surface of the tube by rotating the latter.

2. The process of lining the interior surface of iron and steel tubes by heating a bituminous substance until in liquid form, mixing therewith a loading material until the mass assumes a semi-liquid condition, rotating the tube to be lined, heating it while rotating, introducing the molten loaded bituminous substance into the rotating heated tube, distributing such substance over the interior surface of the tube by continued rotation of the latter, and maintaining the rotation until the substance has set as a lining for the tube.

3. The process of lining the interior surface of iron and steel tubes, consisting in heating a bituminous substance until it is in liquid form, mixing therewith a loading material in a proportion to cause the mass to assume a semi-liquid condition, slowly rotating the tube to be lined and simultaneously heating it, introducing the molten loaded bituminous substance into the slowly rotating heated tube, distributing such substance over the interior surface of the tube by rapid rotation of the tube, and apply-

ing a cooling medium to the tube while the latter is rotating to cool the tube and set the lining.

4. The herein described process of lining the interior surface of iron and steel tubes, consisting in heating asphalt to a liquid condition, mixing kieselguhr therewith to cause the mass to assume a semi-liquid condition, rotating the tube to be lined and simultaneously heating it, introducing the molten loaded asphalt into the rotating heated tube, distributing it over the interior surface of the tube by continued rotation of the latter, and maintaining the rotation of the tube until the latter cools and the lining is set.

5. The herein described process of lining the interior surface of iron and steel tubes, consisting in heating asphalt to a liquid condition, mixing kieselguhr therewith in a proportion to cause the mass to assume a semi-liquid condition, rotating the tube to be lined while heating it to a temperature above the melting point but below the flash point of asphalt, introducing the molten loaded asphalt into the rotating heated tube, distributing it over the interior surface of the tube by continued rotation thereof, and maintaining the rotation until the tube cools and the lining has set.

6. The herein described process of lining the interior surface of iron and steel tubes, consisting in heating a bituminous substance to a liquid condition, mixing therewith a loading material of an absorbent nature and into which the asphalt can penetrate until the mass assumes a semi-liquid condition, heating the tube, introducing the molten loaded bituminous substance into the tube while the latter is hot, and evenly distributing it over the interior surface of the tube by rotating the same.

7. Lining the interior surface of iron and steel tubes with a bituminous composition consisting of asphalt having a melting point (ball and ring test) of 160° F., rendering it liquid and while liquid mixing with it a loading material, heating the composition, heating the tube to be lined to 300° F., introducing the hot composition to the interior of the heated tube, and rotating the tube.

8. Lining the interior surface of iron and steel tubes with a bituminous composition consisting of asphalt having a melting point (ball and ring test) of 160° F., rendering it liquid and while liquid mixing with it a loading material, heating the composition to 420° F. heating the tube to be lined, introducing the hot composition to the interior of the heated tube, and rotating the tube.

9. Lining the interior surface of iron and steel tubes with a bituminous composition consisting of asphalt having a melting point (ball and ring test) of 160° F., rendering it liquid and while liquid mixing with it a loading material, heating the composition to 420° F., heating the tube to be lined to 300° F., introducing the hot composition to the interior of the heated tube, and rotating the tube.

10. Lining the interior surface of iron and steel tubes with a bituminous composition consisting of asphalt mixed with a loading material of the same specific gravity as the asphalt, heating the composition, heating the tube to be lined, introducing the hot composition to the interior of the heated tube, and rotating the tube.

11. Lining the interior surface of iron and steel tubes with a bituminous substance which is heated until liquid and, while in the liquid state, is thickened, by the incorporation or admixture therewith of a loading material of the same specific gravity as the asphalt until the mass assumes a semi-liquid condition and, in this condition, it is introduced into the interior of the iron or steel tube, which is also heated, and is then evenly distributed over the inner surface of the tube by rapidly rotating the same.

12. Lining the interior surface of iron and steel tubes with a hot composition, composed of asphalt mixed with a material of the same specific gravity as the asphalt, heating the tube to be lined, introducing the hot asphaltic composition to the interior of the heated tube and then rotating the tube.

13. Lining the interior surface of iron and steel tubes with a bituminous substance which is heated until liquid and, while in the liquid state, is thickened, by the incorporation or admixture therewith of a loading material which will increase the heat resisting qualities of the bituminous substance until the mass assumes a semi-liquid condition and, in this condition, it is introduced into the interior of the iron or steel tube, which is also heated, and is then evenly distributed over the inner surface of the tube by rapidly rotating the same.

14. An iron or steel tube lined centrifugally with a bituminous composition consisting of asphalt and an absorbent loading material, the specific gravity of the loading material being substantially the same as that of the asphalt whereby to prevent the loading material from separating out from the asphalt and accumulating toward the interior wall of the tube or the interior surface of the lining under centrifugal action.

15. An iron or steel tube lined centrifugally with a bituminous composition, consisting of asphalt having keiselguhr intimately incorporated therewith, so as to increase the melting point of the composition above that of the asphalt.

16. A process of lining the interior surface of iron and steel tubes, consisting in

heating a bituminous substance until liquid, mixing therewith a loading material, introducing the molten loaded bituminous substance into the tube and distributing such substance by centrifugal action over the interior surface of the tube by rotating the latter, the loading material being such that it will not separate out from the bituminous substance under the centrifugal action and accumulate towards the inner wall of the tube.

17. An iron or steel tube lined centrifugally with a bituminous composition consisting of asphalt mixed with a loading material whose specific gravity is such that under the centrifugal action it will not accumulate toward the interior wall of the tube or the interior surface of the lining.

18. An iron or steel tube lined centrifugally with a bituminous composition consisting of asphalt having a mineral loading material intimately incorporated therewith so as to increase the melting point of the composition above that of the asphalt, the mineral loading material being spread throughout the asphalt mass and not accumulated to either the interior wall of the tube of the interior surface of the lining.

In testimony whereof I affix my signature.

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