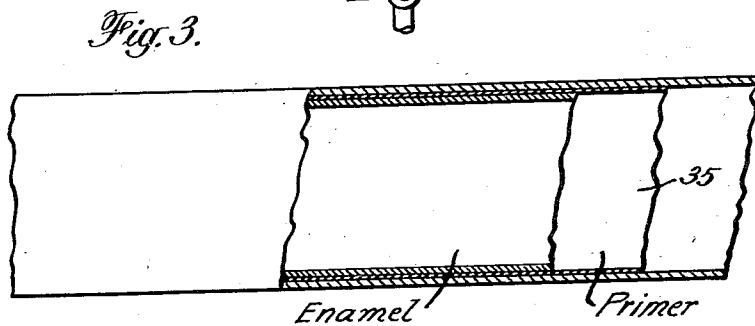
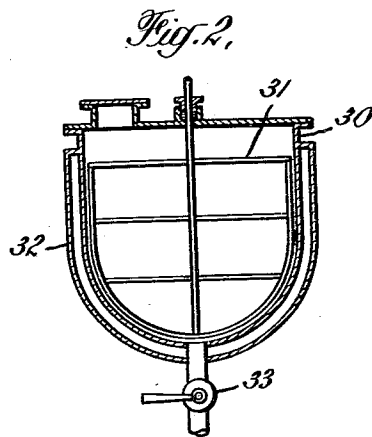
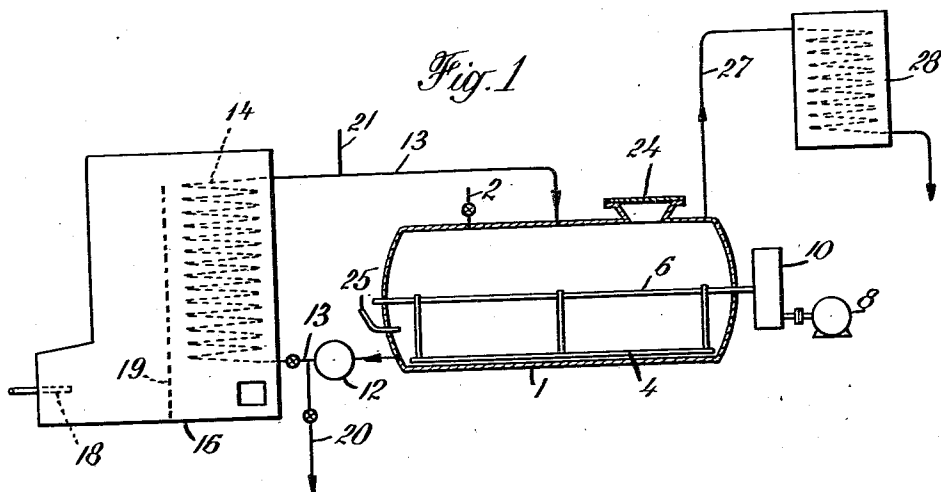


Jan. 7, 1941.

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PROTECTION OF SURFACES
Filed April 16, 1938

2,228,102



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2,228,102

PROTECTION OF SURFACES

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Application April 16, 1938, Serial No. 202,574

14 Claims. (Cl. 91—70)

This invention relates to the protection of surfaces and more particularly to the protection of the surfaces of metal objects such as iron or steel pipes. The invention comprehends the resultant protected metal surface as well as the process of protecting the surface.

An object of my invention is to provide a process for protecting metal surfaces, particularly the surfaces of metal conduits for the conduction of water or other fluids, involving the application of successive bituminous coating layers which form a strong bond with the surfaces and with each other, and result in a composite coating which will not become unduly brittle at low atmospheric temperatures or unduly soft permitting sagging or peeling thereof at relatively high atmospheric temperatures such as encountered when subjected to intense summer heat. Other objects and advantages will appear hereinafter.

In accordance with my invention, I apply to metal surfaces to be protected; e. g., the interior or exterior of metal water mains or other metal pipes employed for conveying fluids, a priming coat constituted of a coal-digestion pitch base, i. e. pitch produced by digestion of coal tar, water gas tar or a mixture of such tar and tar distillate under conditions such that decomposition of the coal occurs (as evidenced, for example, by evolution of the typical liquid and gaseous decomposition products of coal and the production of a pitch which for a given softening point has a higher penetration at 25° C. than a corresponding pitch produced by the distillation of the tar or mixture of tar and tar distillate in the absence of coal) and the non-ash, non-volatile, constituents of the decomposed coal form a homogeneous blend with the tar, and a solvent in amount sufficient to produce a primer of brushable or sprayable consistency. Substantial amounts of the mineral ash constituents of the coal may also be and usually are dispersed in the coal-digestion pitch, the proportion depending somewhat on the physical form of the ash and the digestion conditions. The solvent is of sufficient volatility to permit drying of the primer when exposed to atmospheric conditions by evaporation of the solvent. Preferably the primer contains from 35 to 55 per cent of solvent. After the primer has dried and substantially all solvent evaporated a bituminous enamel, preferably constituted of coal-digestion pitch base and from 10 to 40 per cent of mica, talc, or other filler, is applied in molten condition to the primed pipe surface and allowed to harden by cooling.

The primer and enamel both of which it will be noted have coal-digestion pitch bases, I have discovered as a result of extensive research work in the field, form an exceedingly strong bond with each other and with the metal surface to which

they are applied. This may be attributed to the similarity of the coal-digestion pitch base of the primer and enamel resulting in the intimate bonding and probably in the surface fluxing of the primer with the enamel to form a composite coating which at temperatures encountered in the uses to which the main is put will not become unduly brittle at low temperatures or unduly soft at high temperatures.

In order that my invention may be more fully understood, I shall describe an embodiment thereof in connection with the accompanying drawing wherein,

Fig. 1 is a view illustrating somewhat diagrammatically one form of apparatus which may be employed in producing coal-digestion pitch for use in my primer and enamel;

Fig. 2 is a diagrammatic view of a mixing tank which may be employed in the production of the primer; and

Fig. 3 is a partial sectional view of a pipe, the interior of which is protected in accordance with my invention.

For purposes of exemplification, I have shown in Fig. 1 an apparatus which may be employed for producing coal-digestion pitch base for my primer and enamel involving tank 1 equipped with valved tar or oil inlet 2, oscillating stirrer 4 mounted on oscillating shaft 6, which shaft is journaled in the ends of tank 1 and is driven from motor 8 through oscillating gears illustrated diagrammatically at 10. Reference numeral 12 designates a pump situated in circulating conduit 13 provided with coils 14 located in furnace 16 equipped with a liquid or gaseous fuel burner 18 and baffle 19. Pitch outlet 20 is connected to circulating conduit 13. A thermometer 21 is located in the conduit near the outlet end of coil 14. Tank 1 is equipped with coal charging door 24, thermometer 25, vapor outlet conduit 27 communicating with a condenser 28. In lieu of a still equipped with a heating coil and circulating pump a direct fired digesting apparatus; e. g., apparatus involving a digestion tank such as tank 1 equipped with suitable fuel burners located therebeneath, may be employed.

Coal-digestion pitch may be produced by heating, while agitating, bituminous coal, for example, commercial steam coal, coking coals and certain commercial non-coking bituminous coals, in intimate contact with coal tar, water gas tar, or a mixture of such tar and tar distillate under elevated temperature conditions so that decomposition of the coal occurs and the non-ash, non-volatile constituents of the decomposed coal are blended homogeneously with the tar or tar distillate in which the coal is digested. The temperature to which the coal and tar or tar distillate are heated may vary from about 270° C. to 360° C. but in general the temperature is around

310° C. The heating period in practice may vary depending upon the quantity of material in the heating vessel, the efficiency of the stirring apparatus, the amount of heating surface, etc.

- 5 The proportion of coal used, and the temperature and time of digestion, depends upon the particular type of coal and the character of the tar or tar oil employed. Satisfactory commercial products are obtained by carrying the digestion at least to the point where substantial decomposition of the coal occurs or beyond. It is important to control the degree of decomposition of the coal by controlling not only the time of digestion but the temperature to which it is subjected during digestion. If the digestion temperature is too high, excessive decomposition occurs, and the products begin to lose their characteristic properties, such as relatively low susceptibility to temperature change, and approach ordinary pitch.

- 20 Successful operation of the digestion process requires careful control to effect the desired degree of decomposition of the coal. It has been found that if the digestion is carried out so that no decomposition or only incipient decomposition of the coal occurs, products of a quite different nature than those desired are obtained. If, however, the time and temperature of digestion of a given coal are increased, a relatively sudden change occurs in the consistency of the product together with marked evolution of typical volatile coal decomposition products and a reduction in the content of volatile combustible matter in the digested material. While the temperature and time of digestion necessary to produce the coal-digestion pitch may vary for various kinds of coal and tar or tar distillate in which the digestion is carried out, each mixture of coal and tar or tar distillate should be subjected to definite digestion conditions to accomplish the necessary decomposition of the coal.

- The following example will illustrate the general characteristics of coal-digestion pitch products for the formation of priming compositions and bituminous enamel employed in accordance with the invention: a mixture of approximately equal parts by weight of coke-oven tar and coal-tar heavy oil boiling above 250° C. is introduced into the tank 1 through inlet 2 and circulated by pump 12 through conduit 13 and heating coils 14 until the temperature of the tar in the tank reaches 150° C. or somewhat higher and the agitator 4 is then started running. Bituminous coal in amount equal to about one-third of the weight of the combined tar and coal tar oil charge is then added, preferably in pulverized condition, through charging door 24 and the furnace flame regulated to heat the contents of the still rapidly to a temperature of from about 215° to 240° C. the furnace fire is then regulated to raise the temperature of the effluent from coil 14 gradually until the contents of the tank reach a temperature of about 310° C. or somewhat higher. The temperature of the mixture in the tank is maintained at about 310° C. until the non-ash constituents of the mixture form a homogeneous blend with the coal tar and heavy oil to produce a coal-digestion pitch of desired softening point; usually a substantial fraction of the ash constituents is simultaneously permanently dispersed in the product. Operation of the agitator and pump is then stopped and the contents of the still permitted to settle for an hour or more to remove coarse material, e. g. slate which has not been disintegrated and dispersed by the digestion. The coal-

digestion pitch products may be withdrawn from the tank 1 through valved outlet 20. Vapors escaping through line 27 may be cooled and recovered by means of condenser 28. By carefully controlling the temperatures and time of digestion, coal-digestion pitch of the desired softening point and penetration may be obtained without cutting back the pitch with tar, creosote or other material.

Products especially adapted for use as the base for the priming composition and bituminous enamel in accordance with this invention should contain in general from 15 to 30 per cent of coal and have a penetration at 77° F., 200 grams, 30 seconds, of between 10 and 80, and a softening point (ring and ball) of between 150° and 300° F. Preferably, I use a pitch having a penetration of from 10 to 40 and a softening point of from 180° to 250° F. as the base for the primer. Softening points and penetrations are determined in accordance with procedure (using standard apparatus) prescribed by the American Society for Testing Materials.

In making the primer, coal-digestion pitch produced, for example, as hereinabove described, is charged in a mixing apparatus 30 such as shown in Fig. 2 equipped with a mechanical agitator designated in the drawing by reference numeral 31, a cooling and heating jacket 32 for conveying a cooling agent such as cool water or a heating agent such as steam in heat exchange relation with the mixer and a valved bottom outlet 33. The pitch is introduced in a preheated fluid condition and agitated at a temperature just sufficient to maintain the solution beyond the gel stage in order to permit agitation, i. e. a temperature of about 100° F. above its softening point; e. g. pitch of a softening point of 200° F. (ring and ball) may be heated to a temperature of 290° F. to 300° F. A major portion of the total solvent employed is slowly added in cool condition; i. e. at a temperature of not more than about 100° F., to the molten pitch. To produce a primer containing about 45 per cent of solvent, preferably about two-thirds of the total solvent is added to the pitch in molten condition at the above mentioned temperature.

The temperature of the mixture is then quickly reduced below the softening point of the coal-digestion pitch, preferably below 145° F. by passing water through the cooling system. The remainder of the solvent is then added and the cooling continued until the temperature of the mixture is reduced to below about 100° F. The contents of the mixer are then passed through a colloid mill and minor adjustments in consistency, if necessary, produced by adding small amounts of solvent.

The solvent employed should be sufficiently volatile so that the primer is self-drying upon exposure to the atmosphere. A coal-tar distillate such as is known as coal tar heavy solvent naphtha has been found particularly adapted for use in my priming composition. This distillate may be described as boiling within the range of from about 160° to 220° C. For example, it may have the following distillation range:

	Per cent
Distilled off at 170° C.	5
Distilled off at 180° C.	60
Distilled off at 200° C.	95

It will be noted that a major portion of the solvent distills off at a temperature between 170° C.

and 200° C. Lower boiling coal-tar solvents may also be employed.

The amount of solvent added to the bitumen may vary from 35 to 55 per cent by volume and preferably about 45 per cent is utilized. By careful control of the temperature conditions under which the coal-digestion pitch base and solvent are mixed, as hereinabove described, I obtain a free-flowing liquid primer of brushable or sprayable consistency at atmospheric temperature which is not subject to objectionable sedimentation when stored in closed containers for long periods of time.

The primer may be applied at atmospheric temperatures to metal surfaces which it is desired to protect; e. g., the interior or exterior of metal conduits employed for conveying water or other fluids by brushing or spraying and is then permitted to dry by evaporation of the solvent to form a priming coat as indicated, for example, at 35 in Fig. 3. Under certain conditions, e. g. where surfaces may have collected atmospheric or other moisture, it is advisable to heat the metal before priming to insure application of the primer to a dry surface. For optimum results it is important to permit substantially complete evaporation of the volatile constituents of the primer before application of the enamel hereinafter described. In practice it has been found that in protecting metal pipes substantially complete evaporation of volatile constituents of the primer takes place if the pipe after priming is left exposed to the atmosphere for a period of from 6 to 24 hours.

The enamel used is produced by mixing with molten coal-digestion pitch manufactured as hereinabove described, preferably of a softening point (ring and ball) of from 200 to 270° F. and a penetration at 77° F., 200 grams, 30 seconds, of from 20 to 40, with 10 to 40 per cent ground mica, schist mica, talc or other filler; 25 to 35 per cent of talc forms an economical and satisfactory filler. This enamel may have a softening point of from 210 to 300° C. It is applied in heat-liquefied condition to the primed metal surface and permitted to harden by cooling. The temperature of the enamel when applied may vary within the range of from 450° to 550° C.

In the case of metal pipes, the pipe may be rotated on a rolling rig and the molten enamel distributed thereover while rotating it. The pipe may be heated, if necessary. The enamel forms a coating layer of harder, tougher character than the primer, the principal function of which is to bond the enamel to the surface to be protected.

The coal-digestion pitch base of the primer bonds with the coal-digestion pitch base of the enamel and owing to their similar character, as above indicated, the primer and enamel form a composite coating which bonds firmly to the metal surfaces to which it is applied. The bituminous coatings of the present invention, it has been found in practice neither sag nor peel at elevated atmospheric temperatures, nor become unduly brittle at low atmospheric temperatures and are far superior to bituminous coatings heretofore used. For example, it has been demonstrated by tests that metal surfaces coated in accordance with the invention may be subjected to elevated temperatures; e. g. 160° F., without sagging or peeling and to low temperature (e. g. 0° F.) without cracking or breaking the bond between the coating and the metal.

These tests were made on metal sample pieces protected in accordance with (a) the invention

and (b) the same enamel applied to a priming coat which did not have a coal-digestion pitch base. The coating of the (a) sample showed a firm bond at 77° F., whereas the coating of the (b) sample at the same temperature showed a decided tendency to peel. (a) and (b) test pieces, heated to a temperature of 140° F. and positioned vertically for 5 hours, compared as follows: No sag or shifting of the coating occurred in the (a) sample; the coating in the (b) sample slid or sagged 7" to 8".

Furthermore, the coatings are tough, chemically inert and possess a smooth surface, thereby minimizing friction losses incident to conveyance of fluids through conduits lined with the coatings.

The addition of solvent to the pitch composition in two stages and careful control of the temperature during addition, as above described, appear to be important factors in the production of coating compositions having minimum tendency to sag or peel when applied or to deposit sediment when stored. The complete mechanism of this effect is not known but the reduction to a minimum of the period at which solvent and pitch are mixed at elevated temperatures by my process clearly contributes to homogenous dispersion and solution of the base in the solvent.

The subject matter of this application is related to my copending application Serial No. 202,573, filed April 16, 1938.

It is to be understood that the above description should be interpreted as illustrative and not in a limiting sense and that this invention is not restricted to the above disclosure other than as defined in the appended claims.

I claim:

1. The process of protecting a metal surface comprising coating the surface with a priming composition containing coal-digestion pitch and a solvent, permitting the priming coat to dry by evaporation of the solvent, and applying to the resultant coated surface a bituminous coating material having a coal-digestion pitch base.

2. The process of protecting a metal surface comprising coating the surface with a coating composition containing coal digestion pitch and a solvent, drying the said coating until substantially all volatile constituents are removed therefrom and applying to the resultant coated surface a bituminous coating having a coal-digestion pitch base.

3. The process of protecting a metal surface comprising priming the surface with a coating composition, at atmospheric temperatures, containing coal-digestion pitch and a solvent, drying the priming coating until substantially all volatile constituents are removed therefrom, and applying in heat liquefied condition to the resultant primed surface a bituminous coating material having a coal-digestion pitch base, said coating material being normally solid at atmospheric temperatures.

4. The process of protecting a metal surface comprising applying to the surface a priming coat of bituminous coating composition containing a coal-digestion pitch base and a solvent, permitting the priming coat to dry by evaporation of the solvent, and applying to the primed surface a bituminous enamel comprising coal-digestion pitch and a filler.

5. The process of coating the surfaces of metal pipes comprising priming such surfaces with a primer containing coal-digestion pitch produced by heating a mixture of bituminous coal and tar

together at elevated temperatures until the non-ash constituents of the mixture behave as a homogeneous blend, and a solvent, permitting the priming coat to dry by evaporation of the solvent, applying to the primed surface a bituminous enamel in heat liquefied condition containing a coal-digestion pitch base and from 10 to 40 per cent of mineral filler and permitting the enamel to harden.

6. The process of coating metal pipes, comprising priming a surface of the pipe with a primer of brushable or sprayable consistency constituted of from 45 to 65 per cent of coal-digestion pitch base and from 35 to 55 per cent of a solvent of volatility such that the primer dries by evaporation of the solvent, permitting the priming coat to dry, applying to the primed surface a bituminous enamel in heat liquefied condition constituted of coal-digestion pitch base and from 10 to 40 per cent of finely divided mineral filler and permitting the enamel to harden.

7. The process of coating the surfaces of metal pipes, comprising applying to a surface of the pipe a thin layer of a priming composition constituted of from 45 to 65 per cent of coal-digestion pitch of a softening point (ring and ball) of from 180° to 250° F. produced by heating a mixture of bituminous coal and tar together at elevated temperatures until substantial decomposition of the coal occurs and the non-ash constituents of the mixture form a homogeneous blend, and from 35 to 55 per cent of a solvent, a major portion of which boils within a range of from 170° to 200° C., permitting the priming coat to dry by evaporation of the solvent, and applying to the primed surface a bituminous enamel in heat-liquefied condition containing a coal-digestion pitch base of a softening point (ring and ball) of from 200° to 270° F. and from 25 to 35 per cent of mica filler and permitting the enamel to set for cooling, said enamel layer being harder than said priming layer.

8. A metal article having a surface thereof coated with a layer of coal-digestion pitch adjacent the metal and a layer of bituminous enamel, said layer of coal-digestion pitch firmly bonding said enamel to said metal surface so the enamel does not sag or peel at high atmospheric temperatures.

9. As an article of manufacture, a metal pipe having a relatively thin layer of coal-digestion pitch bonded to the surface of the pipe and a layer of bituminous enamel constituted of a coal-digestion pitch and a finely divided filler bonded to said coal-digestion pitch layer, said coal-digestion pitch layer bonding said enamel layer to said pipe surface so the enamel will not sag or peel at high atmospheric temperatures.

10. As an article of manufacture, a metal pipe having a thin layer constituted chiefly of coal-digestion pitch of a softening point (ring and ball) of from 150° to 300° F., bonded to the surface of the pipe and a layer of bituminous enamel constituted of coal-digestion pitch of a softening point (ring and ball) of from 200° to 270° F. and 10 to 40 per cent of finely divided talc filler bonded to said thin coal-digestion pitch layer, said coal-digestion pitch layer bonding said enamel layer to said pipe surface so the enamel will not sag or peel at high atmospheric temperatures.

11. The process of coating the surfaces of metal pipes, comprising applying to a surface of

the pipe a thin layer of a priming composition constituted of from 45 to 65 per cent of coal-digestion pitch of a softening point (ring and ball) of from 180° to 250° F., produced by heating a mixture of bituminous coal and tar together at elevated temperatures until substantial decomposition of the coal occurs and the non-ash constituents of the mixture form a homogeneous blend, and from 35 to 55 per cent of a solvent, a major portion of which boils within a range of from 170° to 200° C., permitting the priming coat to dry by evaporation of the solvent, and applying to the primed surface a bituminous enamel in heat-liquefied condition containing a coal-digestion pitch base of a softening point (ring and ball) of from 200° to 270° F. and from 25 to 35 per cent of talc filler and permitting the enamel to set for cooling, said enamel layer being harder than said priming layer.

12. The process of coating the surfaces of metal pipes which comprises applying to a surface of the pipe a thin layer of a fluid priming composition constituted of from 45 to 65 per cent of coal-digestion pitch of a softening point (ring and ball) of from 180° to 250° F. produced by heating a mixture of tar and bituminous coal in amount equal to about 15 to 30 per cent of the mixture together at elevated temperatures until substantial decomposition of the coal occurs and the non-ash constituents of the mixture form a homogeneous blend, and from 35 to 55 per cent of a solvent, the major portion of which boils within a range of from 170° to 200° C., permitting the priming coat to dry by evaporation of the solvent and applying to the primed surface a coal-digestion pitch enamel in heat liquefied condition containing a coal-digestion pitch base of a softening point (ring and ball) of from 200° to 270° F., and from 10 to 40 per cent of finely divided solid filler at a temperature of from about 450° to 550° C., and permitting the enamel to cool, said enamel layer having a softening point of from about 210° to 300° C. and being harder than said priming layer.

13. The process of protecting a metal surface which comprises applying to the surface a coat of a priming composition comprising coal digestion pitch and a volatile solvent, permitting the priming coat to dry by evaporation of the solvent, and applying to the resultant coated surface a bituminous coating enamel having a coal digestion pitch base, the priming composition being prepared by heating coal digestion pitch to a temperature above its softening point to reduce it to a molten fluid condition, adding a volatile solvent to the molten pitch, cooling the mixture and adding an additional amount of solvent.

14. The process of protecting a metal surface comprising applying to the surface a coat of a priming composition comprising coal digestion pitch and a volatile solvent, permitting the priming coat to dry by evaporation of the solvent, and applying to the primed surface a bituminous enamel in heat-liquefied condition and containing coal digestion pitch and from 10 to 40% mineral filler, and permitting the enamel to harden, the priming composition being prepared by heating coal digestion pitch to a temperature about 100° F. above its softening point, adding a volatile solvent, cooling the mixture and adding an additional amount of the solvent.

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