Dec. 18, 1934. C. S. McDONALD ET AL 1,984,649

PROTECTIVE COATING AND OBJECTS COATED THEREWITH

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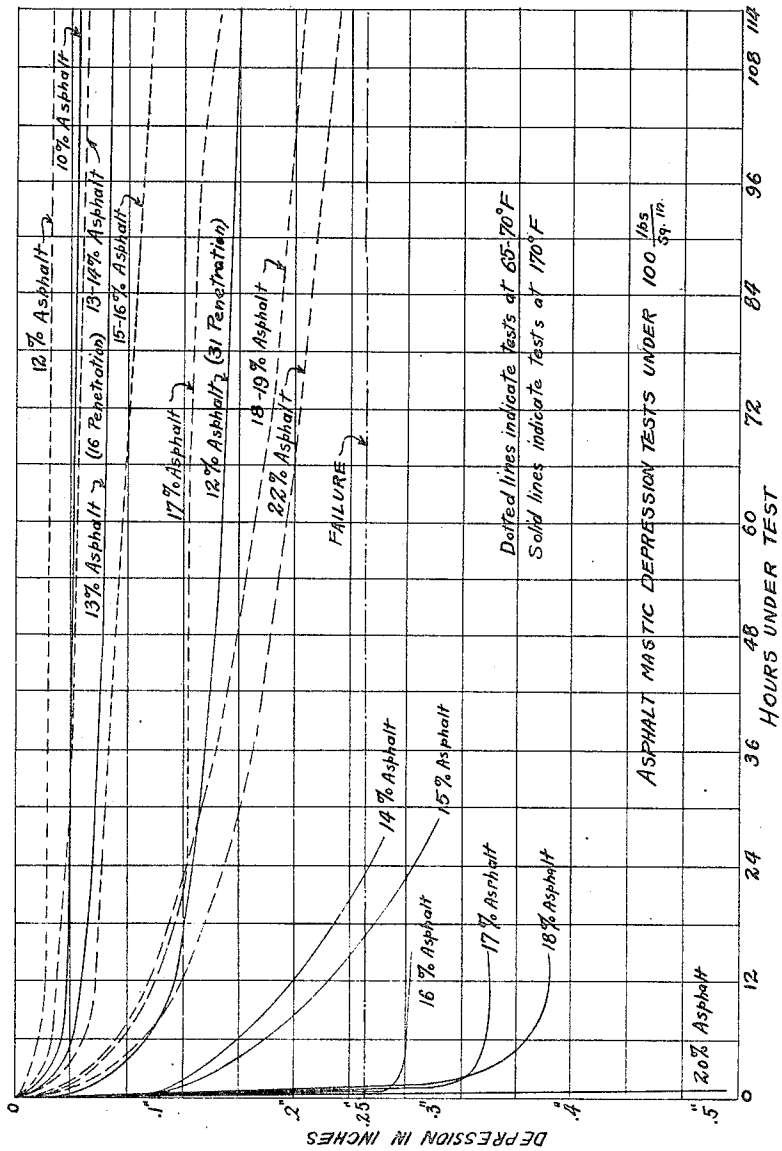


Fig. 1.

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Fig. 2.

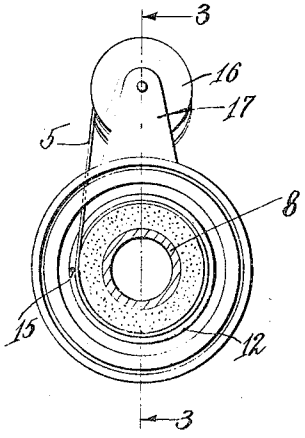
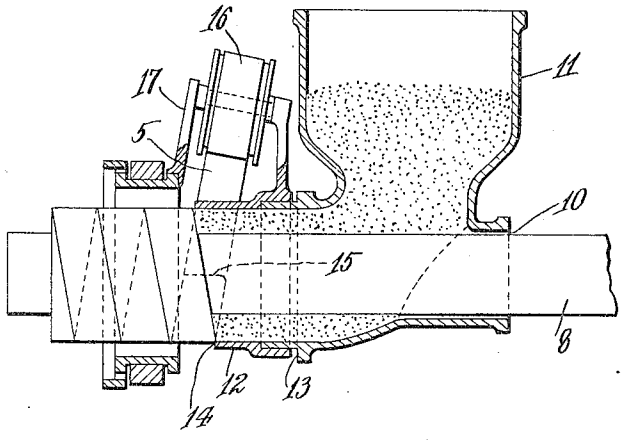


Fig. 3.



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PROTECTIVE COATING AND OBJECTS COATED THEREWITH

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Application December 7, 1929, Serial No. 412,354

10 Claims. (Cl. 91—68)

This invention relates to a coating composition capable of being applied to various objects such as pipes, tanks, and the like, and to the coated objects, the composition being characterized by its ability to withstand relatively high temperatures without deformation and its ability to protect the pipe, container, or other object from corrosion when said object is placed underground. Although the method and the composition embraced by this invention may be applied to various objects, such as cylinders, tanks and other forms of equipment, the subsequent description will be particularly directed toward the adaptation of the method and of the composition to the covering of pipes, particularly to pipe for underground service.

Many substances have been employed for the protection of pipe lines from corrosion, among them being bitumen in various forms such as coal-tar residues, natural asphalts and petroleum asphalts.

While the pure bitumens are good substances for coating pipes because of their waterproofing and insulating characteristics, they have several disadvantages when they are employed in accordance with the various methods of the prior art. Furthermore, the coatings obtained by the use of pure bitumens are incapable of completely protecting the pipe from corrosion when subjected to mechanical abrasions, soil pressure and/or temperature fluctuations.

All bitumens have a tendency to flow when subjected to heat and/or pressure. Hard bitumens which do not flow readily in moderately high temperatures have a tendency to crack when cool. Thus, it will be seen that if pipes or the like are coated with the usual types of bitumens without providing means for reinforcing or protecting the bitumen against flow, the bitumen will not remain on the pipe under pressure and temperature conditions encountered in practice.

In order to overcome this difficulty, the bitumen in the past has been protected by wrappings of cloth, paper, asbestos, felt or the like. While the wrapping improves the coating by retaining the bitumen in place to a greater degree, nevertheless this expedient has not been entirely successful. After a pipe coated with pure bitumen and wrapped has been in use for a period of time, the bitumen flows away from the top of the pipe or is pushed up from the bottom and the fabric is disintegrated by soil pressure or moisture.

As it has been found impossible to apply a thick coating of bitumen to pipes, the normal coatings are only about $\frac{1}{8}$ of an inch in thickness. These coatings are so thin that a slight depression causes the bare pipe to be exposed to corrosion.

In view of the numerous disadvantages of prior coatings, numerous attempts have been made to provide a more stable pressure resisting, closely adhering protective coating. It is particularly desirable to provide means whereby the thickness of the bituminous coating can be increased while preventing the usual objectionable flow of the bitumen. Some attempts have been made along this line by adding a small quantity of finely divided mineral matter to the bitumen, but it has been found that such coatings or enamels do not maintain their bond with the pipe under operating conditions.

We have found that certain mastics can be made which are excellent protective coatings for pipes or other objects, and that such mastics can be readily applied to the pipe by employing a method new in the art, as disclosed and claimed in our co-pending divisional application Serial No. 504,726. By bituminous mastics is meant a bitumen composition containing a relatively large percentage of inert mineral aggregates, as will be hereinafter explained.

An object of the present invention is to provide a bituminous coating which can be applied to a pipe or other object in a layer of appreciable thickness with or without the use of protective wrappings.

Another object is to disclose and provide a bituminous coating which is extremely resistant to depression but which can be readily applied to a pipe.

Another object is to disclose and provide a particular combination of elements in a bituminous coating adapted for use as a protective material.

Another object is to disclose and provide a bituminous mastic coating for pipes and the like, which is stable under relatively high temperature conditions, maintains its bond with the pipe, and is extremely resistant to depression by mechanical pressure.

A still further object is to disclose and provide pipes, tanks, containers, and other objects provided with external coatings of bituminous mastic, such coatings being of appreciable thickness and designed to protect the pipe from corrosion.

Other objects, uses and advantages of this invention will become apparent from the following description and drawings, in which:

Fig. 1 is a graph showing the depression characteristics of various mastic compositions.

Fig. 2 is an end elevation, partly in section, of one device whereby the method of applying a thick coat of bituminous mastic may be carried out.

Fig. 3 is a side elevation of the device illustrated in Fig. 2.

As stated hereinabove, the present invention particularly concerns itself with the use of a bituminous mastic of such composition that it is extremely resistant to depression and flow at high temperatures, does not crack on cooling, is a good electric insulator and is water-proof.

Attempts have been made heretofore to employ asphalt or other bitumen, but ordinary asphalt can not be successfully applied to a pipe because it flows too readily when heated to workable temperatures, and even though a strip of asphalt were wrapped upon the pipe it would not provide a suitable coating because it is not sufficiently resistant to depression.

By depression as used herein, reference is had to the test whereby the effect of a combination of high temperatures, heavy loading and severe bearing surfaces on the coated pipe is determined. In carrying out the tests, samples of 2 inch pipe three feet long coated with a ⅜ inch coating of mastic were employed; the coated lengths of pipe were placed in a box with varied types of bearing surfaces such as sharp angles or rocks, a 50 lb. weight was suspended from each end of each pipe, giving a total load well in excess of 100 lbs. Water at a temperature of 170° F., was circulated through the inside of the pipes during daylight hours, so that each specimen was subjected to several cycles of heating and cooling. The results of the test were recorded with respect to the thickness of the coating at the various bearing points, the condition of the bond between the coating and the pipe, and the presence of cracks.

In this manner the physical durability of the coating was determined, the test representing a slightly exaggerated set of conditions, but representing conditions which an oil pipe line encounters occasionally. In practice, hot oil is often circulated through pipe lines which rest on a rocky sub-soil. The weight of the pipe and oil contained therein is, of course, supported on the rocky bottom of the ditch, and if the protective coating is incapable of preventing the rocks from penetrating the coating, then the coating is displaced from the pipe and the bare pipe surface exposed to the action of soil moisture, etc. The preferred mastic should be capable of maintaining its molded form at temperatures of about 170° F.

A somewhat different depression or penetration test may be employed and give results comparable to the results obtained in the manner described hereinabove. A metal mould ½ inch thick having a cylindrical opening 2 inches in diameter extending therethrough may be filled with hot mastic and leveled off. After being allowed to cool, the mould containing the mastic is then immersed in a water bath at 170° F. (or some other arbitrary figure representing maximum temperature conditions encountered in practice), and the mastic subjected to a steady pressure of 50 lbs., on a plunger having a cross sectional area of ½ square inch, thereby subjecting the mastic to a pressure of 100 lbs. per square inch. The deflection of the bearing arm is then recorded from time to time, and the test continued until the mastic fails completely, or until the rate of depression can be determined.

In the course of development of this invention an electrical break-down test was employed, such test comprising placing 2 ft. lengths of 2 inch pipe coated with a ⅜ inch thickness of mastic in boxes filled with sand moistened with salt water. A steel plate at the bottom of the box formed one electrode, whereas the metal of the pipes formed the other electrode of a 6 volt circuit. Any decrease in the resistance of the circuit indicated a failure in the coating. By means of this test it was found that mastics which were suitable from the standpoint of depression and ease of handling and came within the specified composition disclosed hereinafter were electrolysis proof and resistant to moisture.

The term "asphalt mastic" as used herein in reference to the bituminous coating embraced by this invention refers to a mixture of asphalt compounded with a mineral aggregate, wherein the amount of asphalt is less than the amount of aggregate. By "mineral aggregate" reference is made to small crushed rock, gravel, sand, limestone dust, Portland cement or the like. The preferred aggregate and filler is of approximately the following proportions:

	Percent passing screen	Percent retained on screen
8 mesh	100	0
28 mesh	90	10
48 mesh	73	17
100 mesh	37	36
200 mesh	17	20
Less than 200 mesh		17
Total aggregate		100

It was found desirable to use a mixture of coarse and fine aggregate, that is, a graded aggregate. The normal type of aggregate differs from that given hereinabove in that it contains a much higher proportion of coarse material. For example, the normal asphalt surfacing contains about 57% which will remain on a 48 mesh sieve, whereas the preferred type of aggregate to be employed in bituminous coatings in accordance with this invention contains only about 25% of material coarser than 48 mesh. Whereas, the preferred aggregate to be employed in a bituminous pipe wrapping mastic in accordance with this invention contains from 15 to 20% of material passing a 200 mesh sieve, the normal aggregate as used heretofore contained only about 5 to 10% of material finer than 200 mesh.

Attention is called here in detail to the grading of the sand and aggregate, as it has been found that it is necessary to employ an aggregate graded so as to produce a mixture of maximum density in order to form a bituminous mastic which is sufficiently plastic and workable to be applied readily in the form of a thick coating. The asphalt then employed in conjunction with the aggregate not only fills the voids, but also coats the particles of aggregate and cements them together. An aggregate of coarse rock or gravel alone results in the presence of objectionable voids and reduces the wearing qualities, resistance to deformation and resistance to electrolytic action.

The methods for producing a mixture of maximum density are well known in the art and will not be described herein, except to point out that a "filler" is contained in the aggregate. By the term "filler" we mean any finely comminuted material such as Portland cement, stone dust, limestone dust, etc. We find that with a mastic comprising about 70% of graded mineral aggre-

gate of between 8 to 200 mesh and about 15% of asphalt, the amount of filler should be about 15% by weight of the total mastic.

We have found it advantageous to add a relatively small amount of a so-called additive agent or reinforcing agent to the asphalt before mixing in the mineral aggregate. The additive agent may be comprised of fibrous material such as asbestos fibre or such materials as finely pulverized magnesia, diatomaceous earth or the like. It has been discovered that from 1 to 5% of such additive agents produce the results desired. The preferred amount is usually less than 3%. These values are weight percentages of the total mastic. The purpose of the additive agent is to raise the softening point of the mastic, and thereby increase its resistance to depression.

It has been found that the penetration or melting point of the asphalt has little effect on the qualities of the mastic. Asphalts of about 30 to 33 penetration may be used successfully, and the air blown asphalts are preferable. Furthermore, it has been found that the proportion of asphalt in the mastic should be kept below 25% by weight of the mixture. If more than about 25% of asphalt is employed the wrapping will not stand the pressure imposed thereon at temperatures above normal.

However, less than 10% of asphalt can not be successfully used as then there is very little, if any, bond between the bituminous coating and the pipe. The preferred range is, therefore, 10% to 25% of asphalt, and most generally about 10 to 18%.

In general, therefore, it has been found that a bituminous composition containing less than 25% of asphalt, and preferably from 10 to 18% of asphalt, 75 to 90% of an aggregate containing about 17% finer than 200 mesh, produces a coating of the desired characteristics and of a character which may be extruded or applied in the form of a thick ribbon.

In applying the bituminous mastic described hereinabove to pipe, the pipe may be preheated, although such preheating is not necessary. Furthermore, it may be desirable to cool the pipe immediately after wrapping. The preheating can be readily accomplished by any suitable means, such as the use of a torch, and the cooling may be accomplished by means of a cold water spray.

In addition, a priming coat of asphalt may be applied to the pipe before the bituminous mastic is applied thereto.

The bituminous mastic which it is desired to apply to a pipe is first heated until it becomes plastic. The plasticity generally depends upon the temperature, the penetration or melting point of the asphalt and the amount of asphalt in the mastic. Mastics coming within the scope of this invention become plastic without becoming fluid at temperatures ranging between 250° F., and 450° F. Preferably, in preparing the mastic the mineral aggregate, such as sand and filler, is heated separately to a temperature approximating that of the asphalt, and the finely divided additive agent such as asbestos fibre, diatomaceous earth or other finely divided mineral is added to the hot asphalt so as to produce a homogeneous mixture before the aggregate is mixed therewith.

The preferred method of applying the mastic to the pipe is by supporting a strip of mastic of the desired width and approximate desired thickness on a tape and wrapping the tape and mastic spirally upon the pipe so that the edges of the laps of mastic abut against each other.

The tape may be made from paper, asphalt saturated fabric, sheet metal and the like. Relatively hard strong paper such as kraft paper, or even cardboard may be employed. When metal is used it should have a thickness of say from .002 to .010 inches.

When paper wrappings are employed, they may be left on the pipe as they afford some resistance to initial depression. The metal tape may be removed if desired. If metal tape is employed for applying the mastic, a continuous belt of said tape may be used so as to continually wrap, unwrap and rewrap. The tapes may be of any desired width.

We find that it is difficult to make a strong bond between the edges of adjacent laps unless the tape is held under sufficient tension to squeeze a small quantity of mastic out from under the edges of the tape. The mastic so squeezed out prevents the laps of tape from abutting and makes a spiral welt around the pipe. The excess mastic may be scraped off or rolled down, but we find that a strong joint and neat appearing wrap is made if a narrow tape is wrapped over the welt. A stiff paper or cardboard makes a good tape.

The coating thus applied may vary in thickness within considerable limits, but should be thick enough to resist considerably depression and distortion under whatever load may be encountered under working conditions. Generally, the thickness of the mastic should increase with the diameter of the pipe. Coatings ranging in thickness from ¼ inch to ¾ of an inch are suitable for coating pipes.

In applying mastic in a somewhat different manner, the device shown in Figs. 2 and 3 may be employed. As shown in the drawings the pipe 8 passes through a port 10 in a feed hopper 11 which extends completely around the pipe 8. A rotating nozzle 12 may be mounted upon an outlet 13 extending completely around the pipe 8 and attached to the feed hopper 11, the outlet 13 being spaced from the outer surface of the pipe 8 a distance equivalent to the thickness of the desired coatings.

The nozzle 12 terminates in a helical edge 14 having a step 15 therein, said step being equivalent in width to the width of the tape being applied. The rotating nozzle 12 also preferably carries a roll of tape 16 mounted upon a suitable support 17 extending from the nozzle. The step 15 is positioned at substantially that point of the periphery of the nozzle which comes in contact with the tape. The pipe 8 is then moved longitudinally only in the direction of the arrow, while the tape 16 and the nozzle 12 rotate about the pipe, thereby helically winding the tape 16 over the coating of bituminous material formed on the pipe in the outlet 13.

It is to be understood that the nozzle 12 may be rotated in any desired manner at a speed depending upon the width of the tape 16 and the longitudinal speed of the pipe 8.

The method of applying the mastic described in connection with Figs. 2 and 3 has been termed the "extruding" method, as distinguished from the "wrapping" method in which the mastic is wrapped spirally upon the pipe. When applying mastic by the "extrusion" method it is not essential that the extruding nozzle be rotated as indicated in Figs. 2 and 3. The same effect can be obtained by rotating the pipe and passing it spirally through a stationary nozzle and compression chamber.

While the foregoing description of a preferred

embodiment of the invention utilizes a hot bituminous mastic applied to a pipe while in a hot plastic state, the invention also includes the use of cold but plastic bituminous mastics of the emulsion type. The methods of preparing bituminous emulsions are well known and need not be described here. It may be stated, however, that if the use of an emulsion is objectionable because of the possibility of the water coming in contact with the pipe and thereby corroding the pipe, corrosion inhibitors may be added to the water which is used in preparing the emulsion. Such inhibitors are well known and include such substances as chromates and the like.

It will thus be seen that a new and novel material has been provided, as well as a method of applying the same to pipes, tanks or other containers. The coated and protected pipe, tanks, etc., have extraordinary durability and life even when buried in soils which are notorious for their ability to cause corrosion. Although a particular composition has been described in great detail, it is to be understood that the invention is not limited thereto, but includes all such modifications and changes as come within the scope of the appended claims.

We claim:

1. A pipe or container for underground service having a bonded external coating of bituminous mastic of such thickness as to protect the pipe or container from corrosion, said coating resisting mechanical abrasion, soil pressure and/or temperature fluctuations consisting of a tape bearing a moulded body thereon, said moulded body consisting of a bituminous mastic consisting essentially of 10 to 25 per cent by weight of asphalt, 90 to 75 per cent by weight of a graded mineral aggregate, and not more than about 5 per cent of a finely divided additive agent, said molded mastic body being adapted to substantially maintain its form at temperatures up to about 170° F. and to become plastic without becoming fluid at temperatures of between 250° F. and 450° F.

2. A pipe or container for underground service having a bonded external coating of bituminous mastic of such thickness as to protect the pipe or container from corrosion, and which resists mechanical abrasion, and/or temperature fluctuations and having the property of resisting depression and flow at temperatures up to 170° F., and resisting cracking at lower temperatures, comprising a graded mineral aggregate not exceeding about 8 mesh in size and asphalt, the asphalt comprising less than 25% of the mastic, said mastic being adapted to become plastic without becoming fluid at temperatures of between 250° F. and 450° F.

3. A pipe or container for underground service having a bonded external coating of bituminous mastic of such thickness as to protect the pipe or container from corrosion, and which resists mechanical abrasion, and/or temperature fluctuations and having the property of resisting depression and flow at temperatures up to 170° F., and resisting cracking at lower temperatures, comprising a graded mineral aggregate not exceeding about 8 mesh in size and asphalt, the asphalt comprising less than 15% of the mastic.

4. A pipe or container for underground service having a bonded external coating of bituminous mastic of such thickness as to protect the pipe or container from corrosion, said coating resisting mechanical abrasion, soil pressure, and/or temperature fluctuations, said mastic body being adapted to substantially maintain its form at temperatures as high as 170° F., and comprising a graded mineral aggregate not exceeding about 8 mesh in size, a finely divided inorganic filler and asphalt, the asphalt comprising less than 15% of said mastic.

5. A pipe or container for underground service having a bonded external coating of bituminous mastic of such thickness as to protect the pipe or container from corrosion, and which resists mechanical abrasion, soil pressure, and/or temperature fluctuations consisting of 10 to 25% by weight of asphalt, 75 to 60% of graded mineral aggregate of between 8 and 200 mesh, and about 15% of filler, said mastic being adapted to be molded to form a body adapted to maintain its form at temperatures up to about 170° F. and to become plastic without becoming fluid at temperatures of between 250° F. and 450° F.

6. A pipe or container for underground service having a bonded external coating of bituminous mastic of such thickness as to protect the pipe or container from corrosion, said coating resisting mechanical abrasion, soil pressure, and/or temperature fluctuations consisting of 10 to 25% by weight of asphalt, 75 to 55% of graded mineral aggregate of between 8 and 200 mesh, about 15% of filler, and not more than 5% of additive agent, said mastic being adapted to be molded to form a body adapted to maintain its form at temperatures up to about 170° F. and to become plastic without becoming fluid at temperatures of between 250° F. and 450° F.

7. A pipe or container for underground service having a bonded external coating of bituminous mastic of such thickness as to protect the pipe or container from corrosion, said coating resisting mechanical abrasion, soil pressure, and/or temperature fluctuations, consisting of 10 to 25% by weight of asphalt, 70 to 90% of a graded mineral aggregate of between 8 to 200 mesh, and not more than 5% of a finely divided additive agent, said mastic being adapted to form bodies capable of becoming plastic without becoming fluid at temperatures of between 250° F. and 450° F.

8. A pipe or container for underground service having a bonded external coating of bituminous mastic of such thickness as to protect the pipe or container from corrosion, said coating resisting mechanical abrasion, soil pressure, and/or temperature fluctuations, consisting of 10 to 25% by weight of asphalt, 90 to 70% by weight of a graded mineral aggregate not exceeding about 8 mesh in size, and not more than about 5% by weight of asbestos fibre, said mastic being adapted to form bodies capable of becoming plastic without becoming fluid at temperatures of between 250° F. and 450° F.

9. A pipe or container for underground service having a bonded external coating of bituminous mastic of such thickness as to protect the pipe or container from corrosion, and which resists mechanical abrasion, soil pressure, and/or temperature fluctuations, said coating consisting of a bituminous mastic composed essentially of a graded silicious mineral aggregate not exceeding about 8 mesh in size and asphalt, said asphalt comprising less than 25% of said mastic, said mastic coating being adapted to substantially maintain its form at temperatures up to about 170° F. and to become plastic without becoming fluid at temperatures of between 250° F. and 450° F.

10. A pipe or container for underground service having a bonded external coating of bituminous mastic of such thickness as to protect the pipe

or container from corrosion, and which resists mechanical abrasion, soil pressure, and/or temperature fluctuations, said coating consisting of a bituminous mastic body adapted to substantially maintain its form at temperatures up to about 170° F., said bituminous mastic body consisting of a graded mineral aggregate not exceeding about 8 mesh in size and finely divided inorganic filler and asphalt, the asphalt comprising less than 15% of said mastic coating.

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