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W. E. KEMP

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GASPROOFING LEAKING GAS MAIN

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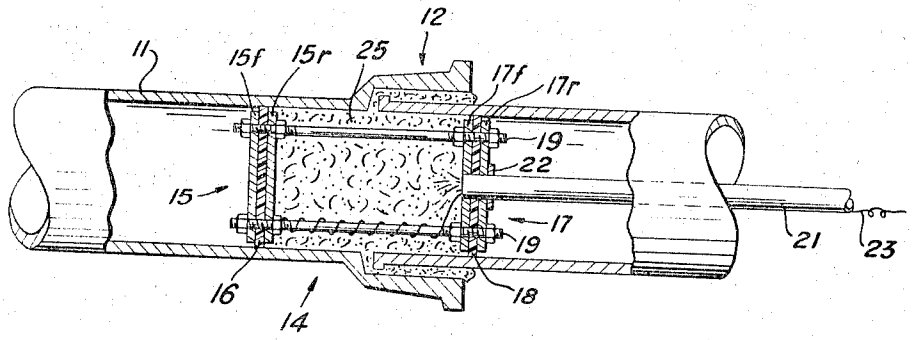


FIG. 1

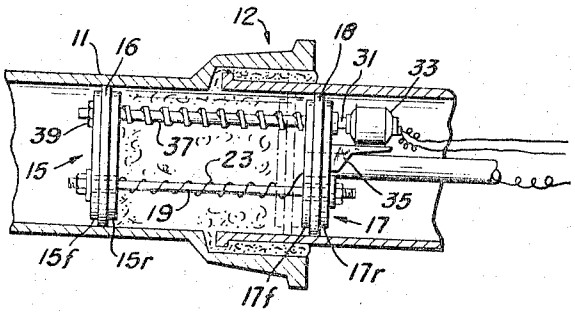


FIG. 2

INVENTOR.
WOODROW E. KEMP
BY J. Armstrong
his Attorney

United States Patent Office

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GASPROOFING LEAKING GAS MAIN

Woodrow E. Kemp, Pittsburgh, Pa., assignor to Koppers Company, Inc., a corporation of Delaware

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This invention relates generally to the internal sealing of pipe joints in place and a composition usable therefor.

In recent years, most large gas distributing companies have converted from manufactured to natural gas because of its superior properties and lower cost. This conversion has caused a critical leakage problem at bell and spigot joints in gas main lines which have been in service, in many cases, for as long as 65 years. The cause appears to be the absence of moisture in natural gas allowing shrinkage of the jute packing which had been previously maintained in a swelled condition by moisture in manufactured gas. Leakage at some joints has been as much as 2.25 cubic feet per hour. The problem has been further aggravated by the necessity of increasing line pressures in order to meet increased demands.

One solution to the problem is to excavate at the end of each section of cast iron pipe, approximately every 12 feet, and then mechanically seal each bell and spigot joint from outside. However, this is a tedious and very expensive procedure which is extremely inconvenient since gas mains would have to be kept out of service during repair over extended periods of time.

It is, therefore, an object of the present invention to provide a simplified way of sealing bell and spigot joints of cast iron pipes which eliminates the necessity of having to seal each section of pipe externally by using a long-lasting sealing composition which can be readily applied from inside the pipes.

In accordance with the present invention, I have discovered that bell and spigot joints of cast iron pipes be sealed internally by contacting said joints from the interior surface with a sealing composition at a temperature of 200–450° F. and a pressure of 50–200 p.s.i.g. The composition comprises a tar-rubber solution containing from three to seven percent of a copolymer of 45–20 parts by weight of acrylonitrile and 55–80 parts by weight of butadiene in coal tar pitch together with an inert filler. The weight ratio of the tar-rubber solution to the filler is within the range of 19:1 to 3:1 and the composition has a Brookfield viscosity at 250° F. within the range of 1000–14,000 centipoises.

The environment in which the sealing compound is to be used is primarily natural gas with occasional exposure to propane air mixtures or gas produced by thermal cracking of petroleum oil which may contain aromatic oils and heavy unsaturated and aromatic hydrocarbons. In order to be economically feasible, the seal produced between abutting sections of pipe should last for an extended period of at least about 15 years.

The rubber in the tar-rubber solution is a copolymer of acrylonitrile and butadiene, which is comprised of a major portion, 55–80 parts by weight of butadiene-1,3, and a minor portion, correspondingly 45–20 parts by weight of acrylonitrile. It is a commercially available material having a government synthetic rubber designation of GR–A. The higher the acrylonitrile content the harder it is to dissolve the copolymer in the tar; the lower the acrylonitrile content, the less resistance the film has to solvents, such as paraffinic or naphthenic oils.

To facilitate the solution in the coal tar and reduce the mixer schedule time, the copolymer may be broken down on a rubber mill. A convenient copolymer for use in this invention is a butadiene-acrylonitrile synthetic rubber sold under the trademark Hycar and having a Mooney viscosity of from 45–100. The Hycar Type 1442 is sold in crumb form and readily goes into solution. The copolymer additionally gives the film elasticity, ductility, and reduced susceptibility to temperature changes. It has been found that if the amount of copolymer be less than three per cent by weight of the tar, the desired physical properties are not present in the final product and if the amount of copolymer is greater than seven percent, a dispersion of the copolymer in the tar is produced rather than a solution in the tar as is desired.

The coal tar pitch in which the copolymer is dissolved may be of the types conventionally designated as RT–6 to RT–12 which are defined in ASTM Standards D490–47. Such tars have an overall float test, commonly used for testing the viscosity of semi-solid bituminous material, ranging from 20 seconds to 220 seconds as determined by ASTM Test D139–49.

The copolymer is readily dissolved in the tar by maintaining the tar under agitation at an elevated temperature while the copolymer is added to the tar. The copolymer does not dissolve well if the temperature of the tar is below 230° F., but if the temperature be greater than 315° F. the breakdown temperature of the copolymer is approached and the copolymer begins to decompose. The resulting solution can be stored either hot or cold for an indefinite period after the solution of the copolymer in tar without separation or sludging.

The filler serves primarily as a viscosity increasing ingredient. Suitable inert fillers useful in my invention include sand, asbestos fibers, fiberglass, talc, and the like which may be used alone or in mixtures thereof. These are generally used in an amount ranging from about 5–25 percent of the total weight which corresponds to a weight ratio of tar-rubber solution to filler within the range of 19:1 to 3:1. When less than five percent is used, the sealing composition tends to flow out of the joints, whereas when more than 25 percent is used, the composition becomes too viscous to enter the space between the joints. Preferably, the inert filler is added to the tar at a temperature of around 250° F. Alternatively, the filler may be mixed with the copolymer and the mixture added with agitation to the heated tar.

The above and further objects and novel features of the invention will appear more fully from the following detailed description when the same is read in connection with the accompanying drawings. It is to be expressly understood, however, that the drawings are not intended as a definition of the invention, but are for the purposes of illustration only.

In the drawings wherein like parts are marked alike:

FIGURE 1 is an elevational view with portions broken away of an embodiment of apparatus for carrying out the invention; and

FIGURE 2 is an elevational view with portions broken out of another embodiment of the novel apparatus.

Referring to the drawing, FIGURE 1, it is conventional for sections of cast iron pipe 11 to be joined by a bell and spigot joint 12. The bell is a flared portion and the spigot is a beaded portion such that in the pipe line the spigot end slopes into the bell end forming a space therebetween.

Conventionally, the cast iron pipe for such environments has a size between 4–48 inches and primarily in the range of 4–12 inches with the space between abutting sections of pipe being up to one-half inch wide and approximately one inch deep. This piping is subject to some movement as a result of settling and traffic vibrations and as a result of the linear expansion of the cast iron. Typically, the pressure in the six inch section of pipe is from 2–60 p.s.i.g. and the ground temperature is between 30–90° F.

The vibration and expansion of the cast iron pipe results after a period of time in leakage. To repair the seal so as to eliminate this leakage has been a difficult and expensive operation. It has involved, for example, digging holes every few feet and mechanically sealing the bell and spigot joints particularly from the outside joint.

In accordance with this invention there is provided a novel and simple manner of sealing the joints by forcing a sealing composition into the space between the joints internally of the pipe, thereby eliminating the need for uncovering the external surface of the pipe so as to seal the joint. In addition, the invention has the advantage that the seal is internal and therefore in the direction of the tendency to leak thereby blocking leakage which would be difficult to ascertain by visual inspection.

The sealing of the pipe internally is accomplished by a novel apparatus comprising generally a pair of circular discs **15** and **17** separated by spacer member **19** and including a flexible inlet **21** for the sealing composition along with a heating unit **23** for maintaining the sealing composition **25** at an operative viscosity.

Discs **15** and **17** may be substantially identical. In each disc as illustrated herein, the disc comprises a front portion **15***f* of rigid material such as metal, a gasket **16** able to withstand internal pressure during operation, and a rear portion **15***r* of rigid material such as metal. The gasket is thus sandwiched between the front and rear portions and provides a seal so that the assembly has a circumference substantially equal to the inside circumference of the pipe thus maintaining intimate contact therewith. Since these two discs **15** and **17** are held in spaced apart arrangement, a chamber **14** is formed together with the inside walls of the pipe **11** for the sealing composition **25**.

As illustrated herein, the spacers **19** are fastened to discs **15** and **17** so as to maintain the discs parallel to each other and normal to the axis of the pipe. The spacers **19** are advantageously a plurality of rods although other shapes of spacers may obviously be used.

Disc **17** has an aperture therein in which is held the member for introducing the composition under pressure into chamber **14**. As illustrated herein a flexible hose **21** is secured for example by a lock nut **22** to disc **17**. Thus the composition can be introduced into chamber **14** by a suitable source not shown such as a pump and reservoir of the composition.

The composition tends to become less viscous as the temperature increases. Accordingly, the flexible hose **21** is advantageously provided with a means for maintaining the composition flowing through at a predetermined temperature. To this end, a heating element **23**, which may be a metallic resistor, is passed through the flexible hose **21** and around a spacer **19**.

As an illustration of the invention, a suitable tank steam jacketed is charged with the desired quantity of coal tar pitch, RT–12, having a viscosity of 220 seconds float at 50° C. as determined by ASTM Test D139–49. After bringing the temperature of the tar to approximately 300° F. the acrylonitrile-butadiene copolymer known as Hycar 1442 is charged through a chopper while maintaining good agitation with a suitable agitator, e.g., a turbine type. Agitation is continued with frequent sampling for consistency until the rubber is entirely dissolved. This takes approximately 12–16 hours. Thereafter, the temperature is allowed to drop to approximately

250° F. and the fillers, e.g., asbestos fibers and talc, are charged slowly while maintaining agitation. The amount of filler added and the type of filler depends on the end viscosity and the flow characteristics desired for the particular service.

Typically 72.9 parts by weight of the coal tar pitch is charged, followed by 4.6 parts of the copolymer rubber which is dissolved to form a rubber-tar solution. There is then charged approximately ten parts by weight of magnesium silicate, 325 mesh, and short fibered asbestos known as 7M grade 12.5 parts to make a total of 100 parts. After all the ingredients are thoroughly dispersed, the mixture is charged into suitable drums or containers which preferably have been lined with a silicon oil or silicon tight release paper to prevent sticking to the metal container and permits easy removal of the solid sealant.

In the field, the composition is charged into a kettle and heated to a temperature of approximately 250°–300° F. The material which had been solid becomes a liquid at this temperature. The kettle is preferably placed near the excavation that is made to uncover a suitable bell hole in the transmission gas main. After opening the gas main, a heated metallic flexible hose is connected to the kettle containing the molten sealant. This short length of hose in turn is connected to a suitable pneumatic pump. From the pump the flexible hose leads to a traveling plug device, of the type shown in the attached drawings, and this in turn is pulled through the pipe from another bell hole which may be 500–1000 feet distance. The pressurizing pump is started and the traveling pull-plug pulled through the pipe until an electromagnetic locater locates a joint. The pressure is raised to approximately 100 p.s.i.g. The traveling plug kept at that spot for about 60 seconds giving adequate time for the sealant to flow into the joints and seal the pipes. The pressure is then reduced and the plug hauled along the pipe. If a side tap is located by the electromagnetic locater the pressure is dropped completely and the plug rapidly pulled past the opening so that no sealant will enter the service lines. When the next joint is located, the plug is again stopped, the pressure built up, and the sealant forced into the joint as previously described.

The sealed joint is characterized by the following combination of properties:

(1) Impermeability to natural gas, propane-air mixtures and gas produced by thermal cracking of petroleum oil;

(2) A high degree of elasticity, especially in the required temperature range of 30–90° F., to be able to withstand pipe movement as a result of settling, traffic vibrations, and expansion of the cast iron pipe without the sealant becoming brittle;

(3) Formation of an adhesive bond between the sealant and uncleaned cast iron pipe;

(4) A high solvent resistancy, especially to paraffinic and naphthenic oils;

(5) Flow properties of the sealant being such that the sealant will not flow from the sealed joint;

(6) The joints are pressure sealed with the sealant composition in the same direction as the gas tends to flow therefrom; and

(7) A long service life of at least about 15 years to make the sealing process economically feasible.

FIGURE 2 illustrates another embodiment of the novel apparatus for carrying out the invention. In this embodiment the structure is generally similar to the structure of FIGURE 1, that is, having discs **15** and **17** and a flexible hose **21**. However, in this embodiment spacer **19** is fixed to disc **17** but by a suitable seal spacer **19** is movable relative to disc **15**. In addition, through disc **17** extends suitably pressure sealed a shaft **31** of a conventional motor **33** which is secured by conventional means such as, for example, attached to bracket **35**. The shaft of this motor terminates as a thread or worm **37**. This worm

then threads into nut **39** suitably fixed to disc **15**. Thus as the motor turns, shaft **31** threads into nut **39** thereby moving disc **15** relative to disc **17**.

In accordance with this invention, the novel composition is flowed into chamber **14**, thereafter motor **33** is actuated causing thread **37** to turn thereby causing relative movement of discs **15** and **17**. Thus, as the discs move towards each other the pressure on the composition **25** in chamber **14** becomes greater than the pressure in flexible hose **21** causing the sealant composition, which has not flowed into the bell and spigot joint, to flow back into the reservoir. As the discs **15** and **17** contact each other, the chamber has decreased or disappeared so that the apparatus may be moved through the pipe without danger of composition flowing into branch lines.

The foregoing has described a novel manner for sealing the joints of cast iron pipe without the heretofore trouble of digging the pipe to determine where the joints are and visually inspecting the joint to determine the leakage. The composition is permanent, is flexible, and is adhesive and seals the joint in the same direction as the gas which tends to flow from the joint. Thus, if any gas is to flow from the joint, it must first displace the composition. This is contra distinction to the usual type of repair of the joint where the joint is repaired from the outside and the pressure building up within the pipe tends to force away the external seal.

I claim:

1. A method for internally sealing the joint between lengths of pipe comprising the steps:

(a) moving a traveling plug through said pipes to the vicinity of said joint, said plug being adapted to straddle said joint and seal off an environment, within said pipes and on both sides of said joint, from the remainder of said pipes;

(b) flowing into said environment under pressure a sealant comprising a tar-rubber solution containing acrylonitrile and butadiene in coal tar pitch together with an inert filler at a temperature of 200–450° F.;

(c) maintaining said sealant under a pressure in the range of 50–200 p.s.i.g. for a period of time long enough for said sealant to penetrate and seal said joint;

(d) reducing said pressure in said environment to ambient within said pipe; and

(e) moving said traveling plug away from said joint along said pipes.

2. The method of claim **1** including the step:

(a) maintaining the temperature of the sealant in said environment at a temperature in the range of 200–450° F.

3. A method for sealing the joint between lengths of pipe from the inside of said pipes comprising the steps:

(a) moving a traveling plug through said pipes to the vicinity of said joint, said plug being adapted to straddle said joint and seal off an environment, within said pipes and on both sides of said joint, from the remainder of said pipes;

(b) flowing into said environment under a pressure in the range of 50–200 p.s.i.g. a sealing composition at a temperature in the range of 200–450° F. comprising a tar-rubber solution containing from 3 to 7 percent of a copolymer of 49 to 20 parts by weight of acrylonitrile and 51 to 80 parts by weight butadiene in coal tar pitch together with an inert filler, the weight ratio of said tar-rubber solution to said filler being within the range of 19:1 to 3:1;

(c) maintaining said sealant under a pressure in the range of 50–200 p.s.i.g. for a period of time long enough for said sealant to penetrate and seal said joint;

(d) reducing said pressure in said environment to ambient within said pipe; and

(e) moving said traveling plug along said pipe away from said joint.

4. A method for internally sealing the joint between lengths of pipe adapted for carrying a fluid comprising the steps:

(a) moving a traveling plug through said pipes to the vicinity of said joint, said plug being adapted to straddle said joint and seal off an environment, within said pipe and on both sides of said joint, from the remainder of said pipes;

(b) flowing into said environment under a pressure in the range of 50–200 p.s.i.g. a sealing composition comprising a tar-rubber solution containing from 3 to 7 percent of a copolymer of 45 to 20 parts by weight of acrylonitrile and 55 to 80 parts by weight of butadiene in coal tar pitch and an inert filler, the weight ratio of said tar-rubber solution to said filler being within the range of 19:1 to 3:1, said composition having a Brookfield viscosity at 250° F. in the range of 1,000–14,000 centipoises whereby said joint is pressure sealed, said composition flowing into said joint in the same direction as the fluid flow in said pipes;

(c) maintaining said sealant under a pressure in the range of 50–200 p.s.i.g. for a period of time long enough for said sealant to penetrate and seal said joint;

(d) reducing said pressure in said environment to ambient within said pipe; and

(e) moving said traveling plug along said pipes away from said joint.

5. The method according to claim **4** wherein:

(a) said filler is selected from the group consisting of sand, asbestos fibers, glass fibers, talc, and mixtures thereof.

6. A method for internally sealing a leaking joint between lengths of pipe comprising the steps:

(a) locating leaking joint between adjacent lengths of pipe;

(b) moving a traveling plug through said pipes to the vicinity of said leaking joint, said plug being adapted to straddle said leaking joint and seal off an environment within said pipe on both sides of said joint from the remainder of said pipes;

(c) flowing into said environment a sealing composition heated to a temperature in the range of 200–450° F. and comprising a tar-rubber solution containing acrylonitrile and butadiene in coal tar pitch together with an inert filler; and

(d) moving one portion of said plug relative to the remainder of said plug within said pipes so as to exert a pressure on said sealing composition greater than the external pressure around said leaking joint whereby said sealing composition flows into said leaking joint and seals the same.

7. The method according to claim **6** wherein:

(a) said sealing composition comprises a tar-rubber solution containing from 3–7 percent of a copolymer of 49–20 parts by weight of acrylonitrile and 51–80 parts by weight of butadiene in coal tar pitch together with an inert filler, the weight ratio of said tar-rubber solution to said filler being within the range of 19:1 to 3:1.

8. The method according to claim **6** wherein:

(a) said sealing composition comprises a tar-rubber solution containing from 3 to 7 percent of a copolymer of 45 to 20 parts by weight of acrylonitrile and 55 to 80 parts by weight of butadiene in coal tar pitch and an inert filler, the weight ratio of said tar-rubber solution of said filler being within the range of 19:1 to 3:1; and

(b) said composition has a Brookfield viscosity at 250° F. within a range of 1000–14,000 centipoises.

9. The method according to claim **8** including the step:

(a) maintaining the temperature of said sealing composition within said environment in the range of 200–450° F.

10. The method according to claim 9 wherein:
(a) said filler is a substance selected from the group consisting of sand, asbestos fibers, glass fibers, talc and mixtures thereof.

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ROBERT F. WHITE, *Primary Examiner.*

L. S. SQUIRES, T. J. CARVIS, *Assistant Examiners.*