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PROCESS OF AND APPARATUS FOR LINING PIPES

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Fig. 1

Fig. 2

Fig. 3

Fig. 4

Fig. 5

Fig. 6
PROCESS OF AND APPARATUS FOR LINING PIPES

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8 Claims.

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This invention relates to certain new and useful improvements in processes of and apparatus for lining metal pipes, the invention being particularly adapted for the lining of buried pipe. As is well known to those skilled in the art, a great deal of trouble is experienced with water mains due to growths, known technically as tuberculosis, occurring on the inside of the mains. In many locations these growths, which are due to chemicals in the water, so reduce the interior diameter of the mains that the mains are unsuitable for water circulation and distribution. It is necessary in such cases either to clean the mains by drawing mechanical cleaning devices through them by which these growths are scraped out or to replace the mains entirely. Either of these expedients, however, is expensive so far as maintenance of the line is concerned inasmuch as the mains may have to be cleaned yearly which necessitates digging up the streets at fairly short intervals to install the cleaning devices.

The present invention provides a method of and apparatus by which water mains, for instance, may be lined in situ after first cleaning them, thus saving the expense of thereafter cleaning and maintaining these pipes. While the lining material employed may be say from one-eighth of an inch to one-quarter of an inch in thickness more or less so that it reduces the inside diameter of the main to that extent, it has been found by experience and tests that with a smooth surface lining even although the diameter of the main is reduced slightly to the extent mentioned, the resistance to flow of water through the line is about the same as that of the unlined pipe, due to the smooth surface of the lining.

In general, the present invention provides for initially depositing the lining material substantially uniformly or to a uniform depth in the bottom of the pipe to be lined say, for example, throughout a section 500 feet long. It will be understood that sufficient material will be so deposited to line that much pipe. After the lining material has been deposited then it is progressively distributed about the wall of the pipe or main to line the same to the required thickness.

The lining material is preferably of a cementitious nature and it will be appreciated by those who are familiar with the handling of cement that by first depositing the lining material uniformly along the bottom of the main and then progressively spreading or distributing this material about the wall of the main that I am assured the physical and chemical characteristics of the cement will be uniform from one end of the lined pipe to the other, which would not be the case were an attempt made to deposit the material in a heap at one end of the line and then to work it through. The more the cement is worked the more it changes its characteristics.

More specifically the conveyor by which the lining material is initially deposited in the bottom of the pipe or main may take the form of a rubber hose which is drawn through the main to be lined in a deflated condition, the main being opened at the necessary intervals, say at 500 foot intervals, the conveyor carrying the lining material fairly evenly distributed along its upper surface. The loaded hose or conveyor is drawn into the pipe line or main until its leading end reaches the point where the main has been opened, whereupon the conveyor is inflated. This will cause the lining material to slide off the surface of the hose and to be deposited in the bottom of the main. The empty conveyor may then be drawn out of the pipe section in which the lining material has been deposited along the surface of the lining material, leaving a deposit of lining material of a substantially uniform depth along the bottom of the entire length of pipe to be lined.

As the conveyor is being withdrawn a spreader or distributor is drawn into the pipe line. This spreader or distributor may take the form of a motor driven rotor carrying spreading or trawling bushes, for example, which as they contact the lining material distribute the same over the surface of the wall of the pipe line. This distributing or spreading action is progressive, as will be understood, and inasmuch as the lining material has initially been distributed throughout the length of the pipe line or main only the minimum agitation of the lining material is necessary, insuring that the mechanical and chemical characteristics of the lining material will be substantially uniform throughout the entire length of the pipe or main. As mentioned above, this is not true where the lining material is simply dumped into the pipe at one end and must then be pushed through the line and spread at the same time.

The motor and spreader may conveniently be attached to the trailing end of the conveyor so that as the conveyor is being drawn out of the pipe line the motor and spreader will be drawn into it, and if an electric motor is employed it will be appreciated that the leads therefor may be...
pass through the conveyor itself. On the other hand, other forms of motor may be used to equal advantage. For example, an air motor may conveniently be employed in which event the air used for inflating the hose can be used for driving the motor. I may employ a steam driven motor in which event the steam can be supplied to the motor through the conveyor or there may be a separate steam line which can be enclosed in the conveyor. A steam motor has some advantages over an electric motor in that the steam as it exhausts from the motor will engage the lining material which has been spread on the wall of the pipe line behind the spreader and thereby accelerate the curing of the lining material. It is known in the cement industry that the application of a heated fluid such as steam to cement accelerates curing.

My improved method may be carried out continuously throughout mains of unlimited length, the main being first opened at suitable intervals, say just for example at 500 foot intervals, in that after the conveyor has been unloaded in one section of pipe line and is being withdrawn from that section past one of the openings just referred to, it can be drawn directly into an adjacent section of line, and as it is being drawn into this second section it can be loaded through the opening, the motor and spreader at the trailing end of the conveyor at the same time distributing the lining material in the first section of pipe line. It will be appreciated that in such operation the conveyor, if the same is in the form of a hose, after dumping its load in the first section of pipe in order that it may be loaded again as it is being drawn into the second section or length of pipe.

In the accompanying drawing I have illustrated one form of apparatus useful in the practice of my invention:

- Fig. 1 is a cross sectional view of a pipe line or main showing the loaded conveyor therein;
- Fig. 2 is a longitudinal sectional view of the pipe line of Fig. 1 and shows the conveyor in part section;
- Fig. 3 shows the conveyor inflated;
- In Fig. 4 I have shown the conveyor being withdrawn; and
- Fig. 5 is a longitudinal sectional view showing the conveyor being withdrawn and the spreader in operation; and
- Fig. 6 is a section through the spreader.

Referring to the drawing in detail: 2 designates, in all views, the pipe or main to be lined.

It is to be understood, as above pointed out, that this invention is particularly well adapted for use in connection with the lining of buried lines.

4 designates one form of conveyor which may be used in the practice of my invention. As illustrated, this conveyor takes the form of a hose of canvas and rubber, for example, possessing sufficient tensile strength to permit of drawing the same through the main 2 while carrying a load of lining material.

As this conveyor is being drawn into the main lining material 6 is deposited upon the upper face thereof. The loading of the conveyor may be accomplished by the use of a suitable gate so that the lining material which in this case is of a cementitious nature will be deposited more or less uniformly upon the surface of the conveyor as the latter is being drawn into the pipe line. The conveyor at this stage of the process is deflated.

With the load of lining material upon the conveyor or the latter will take the shape approximately as shown in Fig. 1, for instance.

The conveyor with its load of lining material is drawn into the pipe or main 2 until the leading end thereof has reached the far end of the main 5 so as to insure that when the conveyor is unloaded there will be lining material along the bottom of the pipe line or main throughout the length thereof. The conveyor 4 is then inflated, for instance, to cause the cementitious lining material to slide off the conveyor and fall or slide into the bottom of the pipe line or main 2 between the conveyor and the pipe line, as illustrated in Fig. 3. If desired the conveyor may be pulsed to have a slight radial movement or by any other suitable means although I have found that this is usually unnecessary. The conveyor is then withdrawn from the pipe line or main preferably in an inflated condition although it can be withdrawn fairly satisfactorily deflated.

The trailing end of the conveyor is provided with a suitable nose 8 to which a wire rope 10 is attached, this tow line being secured to a motor 12. This motor has been illustrated as an electric motor and it is preferably provided with feet 14 as shown in Figs. 5 and 6 which rest upon the bottom of the pipe line and which will serve to maintain the motor properly located in the pipe. These feet are preferably in the form of plates mounted vertically to permit the same to pass freely through the lining material 6 lying in the bottom of the pipe with the minimum of agitation of this material.

The shaft 16 of the motor 12 carries a distributor or spreader 18. This spreader may take the form of wire brushes or trowels 20 and the brushes may be so mounted as to have a slight radial movement with respect to the pipe to promote their proper functioning, the brushes or trowels as the conveyor is being withdrawn from the pipe picking up the lining material previously deposited in the bottom of the pipe and spreading it on the wall of the pipe so as completely to line the same. The distribution of the lining material is progressive, as will be understood, due to the fact that initially the lining material is deposited to a substantially uniform depth throughout the entire length of the pipe or main at the bottom thereof which will necessitate only the minimum amount of agitation of the lining material in the actual lining operation, thereby insuring that the material, particularly if the same be cement, will be uniform in its physical characteristics throughout the entire length of the line. The leads for the motor 12 may be taken through the conveyor 4. They are shown at 22 in Fig. 5 of the drawing.

As above mentioned, my process may be carried out continuously in which case it will be necessary to deflate the conveyor 4 after it has been unloaded and as the leading end of the same emerges from the main 2 and is being drawn into the next length to be lined it is again loaded with lining material. In the meantime, of course, the spreader or distributor 18 is distributing the lining material in the first length of main. This cycle of operation can be carried on indefinitely through mains of any length.

While I have shown a conveyor 4, which takes the form of a hose or other inflatable device, it is to be understood that conveyors of other form may be employed, as desired, so long as they have the ability to be unloaded after having been drawn into the pipe line.
The motor 12 has been referred to as an electric motor. However, as above mentioned, I may use an air motor and the same air that is employed for inflating the conveyor 4 may be used for driving the motor 12. On the other hand, I may use a steam motor in place of the electric motor 12 and the steam line can be taken through the hose 4. A steam motor has certain advantages over an electric motor in that the steam exhausting from such a motor will engage the lined wall of the pipe line behind the motor 12 thereby accelerating curing of the lining material.

It will be seen from all of the foregoing that the present invention provides a method of and apparatus for the lining of pipe lines or mains particularly well adapted for buried lines, where-in I first of all deposit the necessary amount of lining material to line the entire main in the bottom of the main throughout the length thereof and then proceed to distribute this material progressively about the walls of the main.

It is to be understood that changes in the details of construction and arrangement of parts other than those above mentioned may be made without departing from the spirit and scope of this invention.

What I claim is:

1. Apparatus for lining pipe comprising in combination a conveyor adapted to be drawn into a pipe to be lined, conveying means for unloading said conveyor to deposit the lining material substantially uniformly along the bottom of the pipe, a motor attached to said conveyor, and a spreader driven by said motor, whereby as the unloaded conveyor is being withdrawn said spreader will function to distribute the deposited lining material about the walls of the pipe.

2. Apparatus for lining pipe comprising in combination a hose adapted to be drawn into a pipe to be lined, lining material distributed along the upper face of said hose, means for inflating said hose to unfold the lining material substantially uniformly in the bottom of the pipe, a motor attached to the trailing end of said hose, and rotary brushes carried by said motor and adapted as the hose is being withdrawn to distribute the lining material over the wall of the pipe to line the same.

3. The process of lining pipe with non-metallic plastic lining material, which process comprises moving a conveyor loaded with the non-metallic plastic lining material into the pipe to be lined until the conveyor and its load extend from end to end of the pipe, thereafter unloading the conveyor in a single operation to place the lining material in the bottom of the pipe throughout its length, and thereafter effecting movement of the lining material circumferentially of the pipe to cover or line the entire wall of the pipe.

4. The process of lining pipe with non-metallic plastic material, which process comprises depositing the lining material substantially uniformly upon the face of a conveyor as the conveyor is being moved into the pipe, continuing the advance of the conveyor until the conveyor and its load extend from end to end of the pipe, unloading the conveyor in a single operation to deposit the lining material in the bottom of the pipe throughout the length of the same and to a substantially uniform depth, and thereafter removing the conveyor and progressively spreading the deposited lining material about the wall of the pipe to line the same.

5. The process of lining pipe with non-metallic plastic lining material, which process comprises moving a conveyor loaded with the lining material into the pipe until the conveyor and its load extend from end to end of the pipe, then unloading the conveyor in a single operation to deposit the lining material in the bottom of the pipe throughout its length and to a substantially uniform depth, and thereafter removing the conveyor and effecting movement of a rotating device through the pipe in contact with the lining material progressively to effect movement of the lining material circumferentially of the pipe to cover or line the same.

6. The method of lining pipe with non-metallic plastic material, which method comprises moving a deflected conveyor with the lining material distributed uniformly along its face into the pipe to be lined until the conveyor and its load extend from end to end of the pipe, then inflating the conveyor to unfold it in a single operation and to deposit the lining material in the bottom of the pipe throughout the length of the pipe and to a substantially uniform depth, withdrawing the conveyor and effecting movement of the lining material circumferentially of the pipe in contact with the wall thereof completely to cover or line the same.

7. The process of lining buried pipe with non-metallic plastic lining material, which process comprises moving a conveyor loaded with the lining material into a section of the pipe to be lined until the conveyor and its load extend from end to end of the said pipe section, unloading the conveyor in a single operation to place the lining material in the bottom of the said pipe section throughout its length, then advancing the conveyor into the adjacent section while loading the conveyor with a charge of lining material for the second pipe section, and, as the conveyor so advances into the said second pipe section, effecting movement of the deposited lining material in the first pipe section circumferentially of the first section to line the same.

8. Apparatus for lining pipe, comprising in combination a conveyor for lining material, said conveyor being adapted to be drawn into the pipe to be lined to introduce into the pipe sufficient lining material to line the pipe, means for unloading the conveyor in a single operation to deposit the lining material carried thereby in the bottom of the pipe to a substantially uniform depth throughout the length of the pipe, and a rotatable spreader attached to the conveyor and adapted to be drawn into the pipe as the conveyor is withdrawn, said spreader contacting the deposited lining material to effect progressive spreading of the previously deposited lining material upon the pipe wall.

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