

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
02.07.1997 Bulletin 1997/27

(51) Int Cl.⁶: **B05B 3/10**, B05B 13/06

(21) Application number: **96307992.6**

(22) Date of filing: 05.11.1996

(84) Designated Contracting States:
**AT BE CH DE DK ES FI FR GB GR IE IT LI LU MC
NL PT SE**
Designated Extension States:
AL LT LV RO SI

(72) Inventors:

- **Gunter, Robert Spencer**
Swindon, Wilts SN4 0BG (GB)
- **Whittle, Neil Thomas**
Radcliffe, Manchester M26 3XB (GB)

(30) Priority: **05.12.1995 GB 9524811**

(74) Representative: **Skone James, Robert Edmund**
GILL JENNINGS & EVERY
Broadgate House
7 Eldon Street
London EC2M 7LH (GB)

(71) Applicants:

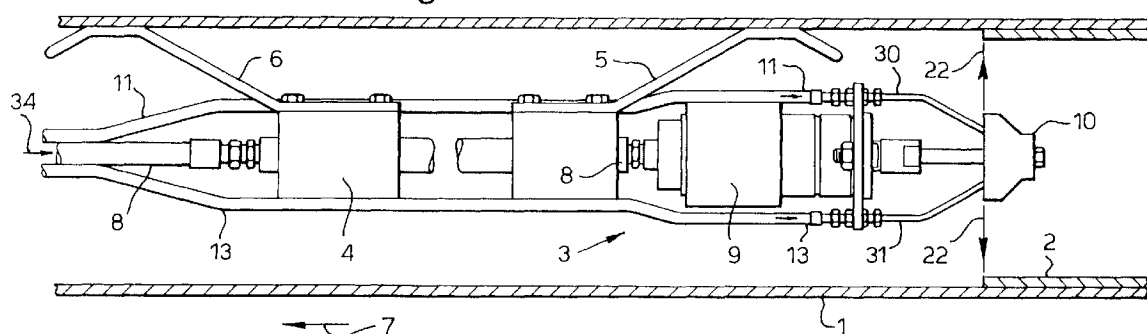
- **AMEC Utilities Limited**
Northwich, Cheshire CW8 2YA (GB)
- **HUNTING INDUSTRIAL COATINGS**
Widnes Cheshire WA8 9ND (GB)

(54) **Method and apparatus for coating the interior of a pipe**

(57) The present invention relates to apparatus for coating the interior of a pipe (1). The apparatus includes a rotating member (10) which may be moved along the inside of the pipe (1) and means (12) for directing a

stream of a liquid resin coating onto the rotating member (10) so that the liquid resin is thrown from the periphery of the rotating member (10) under the action of centrifugal force onto the walls of the pipe (1). The liquid then cures, coating and sealing the interior of the pipe.

Fig.1.



Description

The present invention relates to coating the interior of a pipe.

A known method of coating the interior of a pipe comprises pushing a collapsed sleeve of solid coating material through the length of pipe and sealing the sleeve against the interior of the pipe. This method presents problems when the length of pipe has a second pipe extending from a pipe junction. The coating will seal off the opening of the second pipe. This makes it necessary for machinery to enter the pipe after it has been coated to reopen the junction by removing the coating which is obscuring the opening to the second pipe.

Alternatively the pipe may be coated with a liquid material which cures on the interior of the pipe to provide a solid coating. Typically the coating is an epoxy resin. The two components of the epoxy resin are mixed before spraying onto the interior of the pipe. To prevent the epoxy curing before it is sprayed, it is necessary to use an epoxy which has a relatively long cure time. However, this presents the problem of the liquid flowing to the bottom of the pipe before it cures.

In accordance with a first aspect of the present invention there is provided apparatus for coating the interior of a pipe, the apparatus comprising a rotatable member, drive means for rotating the member in use, means for moving the rotating member in use along the pipe and means for directing a stream of a liquid coating onto the rotating member in use whereby the liquid is thrown from the periphery of the rotating member under the action of centrifugal force and coats the interior of the pipe.

Typically the liquid coating is directed onto the rotating member by one or more nozzles or spray heads.

The apparatus may direct a single stream of liquid only onto the rotatable member. This may be a pre-mixed epoxy resin. Preferably however the apparatus further comprises means for directing a second stream of a second liquid coating onto the rotatable member. This allows the first and second liquids to be kept separate before being directed (typically in the form of a spray) onto the rotating member, whilst allowing the two liquids to mix thoroughly before being thrown from the periphery of the rotating member onto the interior of the pipe.

Typically the first liquid coating comprises a first component of a curable resin and the second liquid coating comprises a second component of the curable resin. The apparatus provides a means of spray coating a pipe with a resin which cures very quickly: of the order of 2 seconds. By keeping the two components of the resin separate before spraying, the apparatus ensures that the resin does not cure before being thrown from the periphery of the rotating member.

The rotatable member may vary from a flat disc to a bell dependent on the pipe size, and the streams of liquid coating are directed onto the interior of the bell or

the surface of the disc. Typical pipe sizes are 150mm-600mm diameter. The two liquids mix on the sides of the bell or disc before being thrown from its periphery. The mixing time can be controlled by varying the rate of rotation of the bell or disc, the diameter of the bell or disc and/or the angle and length of the sides of the bell. The sides of the bell may be curved or flat in cross-section.

The rotation rate of the rotating member and the flow rate of the two streams of liquid coating are typically adjusted such that the two liquids mix on the rotating member, are thrown on to the interior of the pipe in substantially liquid form and subsequently cure on the interior of the pipe.

The apparatus is typically mounted on a chassis which is centralised in the pipe by a number of fingers, such as steel spring fingers. Typically there are two sets of fingers, one at each end of the chassis. Each set typically comprises a plurality of fingers (eg five fingers) arranged symmetrically about the axis of the chassis. Alternatively the apparatus may be mounted on an adjustable chassis.

Typically the liquid coating is fed to the apparatus via one or more umbilical hoses. The chassis may be pulled along the pipe by the hoses, or propelled by pneumatic power.

The choice of mounting/driving methods discussed above depends on the site conditions and size of pipe.

Typically the coatings comprise respective A and B components of a polyurea coating or epoxy resin coating. Typically the coatings are "fast cure" with cure times less than 60 seconds.

The invention extends to a method of coating the interior of a pipe, the method comprising directing a stream of a liquid coating onto a rotating member in the pipe and moving the rotating member along the length of the pipe whereby the liquid is thrown from the periphery of the rotating member under the action of centrifugal force and coats the interior of the pipe.

An embodiment of the present invention will now be described with reference to the accompanying Figures, in which:-

Figure 1 is a side view of the apparatus coating a pipe;

Figure 2 is an enlarged view, with some parts removed, of the spray head and air motor;

Figure 3 is a side view of the bell; and,

Figure 4 is an end view in the direction A with the bell removed.

Figure 1 is a side view of an embodiment of coating apparatus according to the present invention. The apparatus is shown coating the interior of a pipe 1 (shown in cross-section) with a polyurea coating 2. The apparatus comprises a spray head 3 (shown disconnected in Figure 2) which is mounted, in use, on a centralising carriage 4 which is centralised in the pipe by two sets of five radially extending equally spaced steel spring fin-

gers, one at either end of the carriage 4. Figure 1 illustrates one finger (5,6) from each set. The spray head 3 is pulled out along the length of the pipe in the direction indicated at 7.

A compressed air hose 8 is connected to air motor 9. The compressed air 34 drives the air motor 9 which rotates bell 10 up to 16,500 revolutions per minute (rpm).

The base component of a required coating is pumped along base hose 11 and is delivered to the base spraying nozzle 12 (which is located inside the bell 10 and shown in Figure 2) via steel tube 30. The catalyst component of the required coating is pumped along catalyst hose 13 and is delivered to catalyst spraying nozzle 14 via steel tube 31. The diameter of the orifices of nozzles 12,14 is typically 1mm.

Bell drive shaft 15 is screwed into the drive shaft 32 of air motor 9. The bell 10 is shown in Figure 3 with hidden parts indicated in dotted lines and with the bell drive shaft 15 removed. The bell drive shaft 15 has a flange 16 which locates in recess 17 at the apex of the bell. A threaded projection 18 on the end of the bell drive shaft 15 extends through opening 19 in the bell head and is secured with a threaded nut 20.

As shown in Figure 3, the bell 10 has flat sloping sides 21. In an alternative, the sides 21 may be curved either inwardly, or outwardly. The bell is, circular and has a diameter of 49mm and a depth of 29mm. Both parameters may be adjusted, depending on the required coating parameters.

Figure 4 shows a view in the direction A (shown in Figure 2) with the bell 10 removed.

In a coating operation, the spray head 3 and centralising carriage or chassis 4 is located in a pipe to be lined, and connected to compressed air supply hose 18 and base and catalyst hoses 11,13. Compressed air is supplied to the air motor and the bell 10 rotates. When the bell has reached a required rotation rate, liquid coating is sprayed into the bell in the form of a first stream or spray 35 and a second stream or spray 36. The apparatus is pulled out via the supply hoses in the direction 7 shown in Figure 1. The two liquid coating materials introduced into the bell mix within the bell, and centrifugal forces send the combined mixed material along the sloping interior sides 21 of the bell and out at 90° (shown at 22 in Figure 1) towards the pipe.

It is important that the liquid coating does not solidify before it is thrown from the spinning bell 10, to ensure that the bell does not become clogged up with solid material. Conversely it is also important that the liquid coating cures rapidly on the interior of the pipe to prevent the liquid flowing to the bottom of the pipe. The rate at which the spray head is pulled out also clearly effects the thickness of coating.

Preferably the coating has a gel time of less than 60 seconds to prevent the liquid flowing to the bottom of the pipe.

A suitable liquid coating for use in the present in-

vention is a polyurea. Polyureas are typically defined by two components (conventionally known as A and B components) which react to form a polyurea polymer. Typically the A-component is an isocyanate (such as a soft block quasi-polymer based on MDI) and the B-component is typically a primary or secondary amine terminated material. The A-component is applied by the base spray head 12, and the B-component is applied by the catalyst spray head 14. The reaction is normally very fast, proceeding to completion within a few seconds without any catalysts. Typically, working times ("gel times") are less than 3 seconds.

Alternative liquid coatings are fast cure epoxies.

As a typical example a 300mm diameter pipe with a 6mm thick lining would require a withdrawal rate of 2 metres per minute and a combined flow rate of 11.3 litres per minute heated to 50°C using an 86mm dia bell revolving at 16,500 rpm.

Claims

1. Apparatus for coating the interior of a pipe (1), the apparatus comprising a rotatable member (10), drive means (9) for rotating the member in use, means for moving the rotating member in use along the pipe and means (12,14) for directing a stream of a liquid coating onto the rotating member (10) in use whereby the liquid is thrown from the periphery of the rotating member (10) under the action of centrifugal force and coats the interior of the pipe (1).
2. Apparatus according to claim 1 wherein the rotatable member (10) comprises a bell or disc, and the stream of liquid coating is directed into the interior of the bell or onto the surface of the disc.
3. Apparatus according to claim 1 or 2 wherein the means for directing a stream of liquid coating directs a first (35) and second (36) stream onto the rotating member (10).
4. Apparatus according to claim 3 wherein the first and second streams comprise different components of the liquid coating.
5. Apparatus according to claim 4 wherein the first stream (35) comprises a first component of a curable resin and the second stream (36) comprises a second component of the curable resin.
6. Apparatus according to claim 3, 4 or 5 wherein the rotation rate of the rotating member (10) and the flow rate of the two streams of liquid coating are such that the two streams mix on the rotating member (10), are thrown onto the interior of the pipe (1) in substantially liquid form and subsequently cure on the interior of the pipe (1).

7. Apparatus according to any of the preceding claims, wherein the liquid coating is directed onto the rotating member (10) by one or more nozzles or spray heads (12,14). 5
8. A method of coating the interior of a pipe, the method comprising directing a stream of a liquid coating onto a rotating member (10) in the pipe (1) and moving the rotating member (10) along the length of the pipe (1) whereby the liquid is thrown from the periphery of the rotating member (10) under the action of centrifugal force and coats the interior of the pipe (1). 10
9. A method according to claim 8 further comprising directing a second stream of liquid coating onto the rotatable member (10). 15
10. A method according to claim 9 wherein the first and second streams comprise different components of the liquid coating. 20
11. A method according to claim 10 wherein the first stream comprises a first component of a curable resin and the second stream comprises a second component of the curable resin. 25
12. A method according to claim 11 wherein the coatings comprise respective A and B components of a fast cure polyurea coating or a fast cure epoxy resin coating. 30
13. A method according to any of claims 8 to 12, using apparatus according to any of claims 1 to 7. 35

40

45

50

55

Fig. 1.

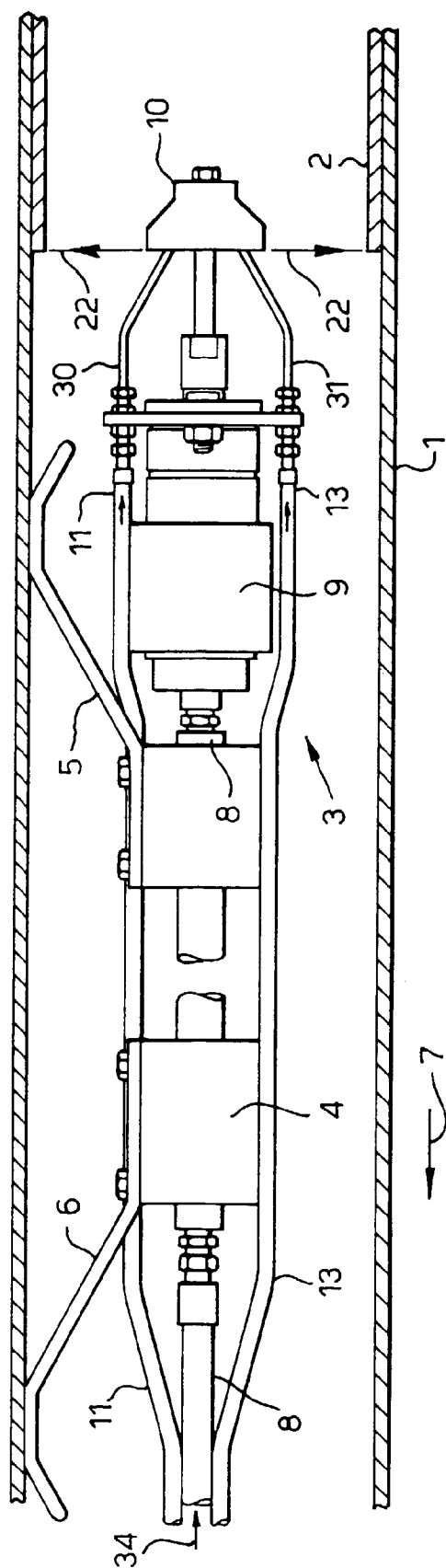


Fig. 2.

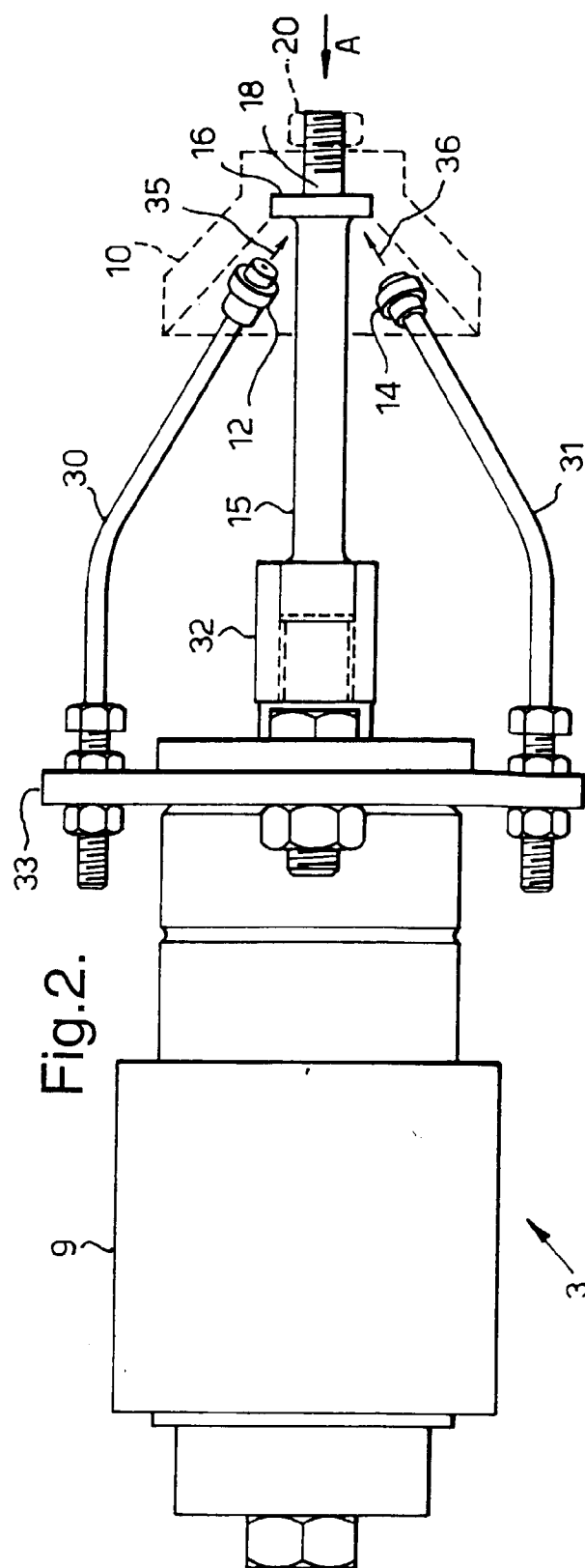


Fig.3.

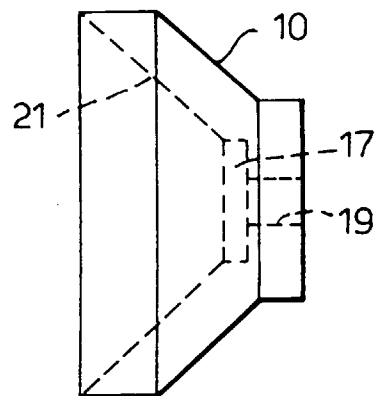


Fig.4.

