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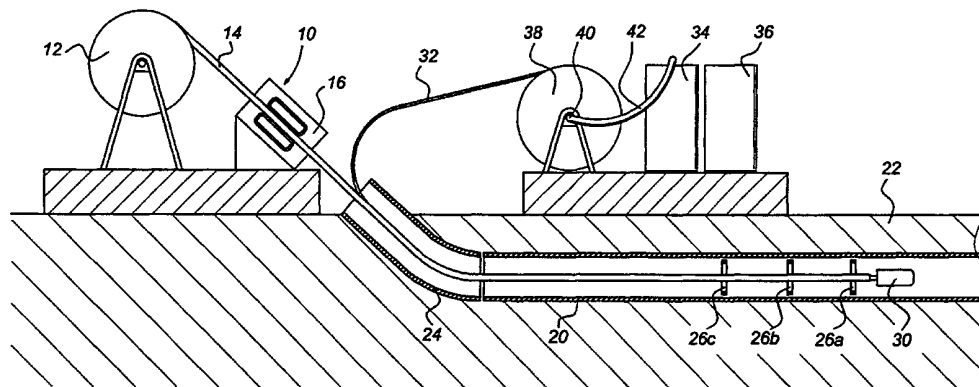
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(54) Title: SYSTEM FOR COATING THE INNER WALL OF TUBES



(57) Abstract: System for coating the inner wall of a pipe (20), a tunnel etc., comprising a) a spray unit (30) for spraying the coating material onto the inner wall of the pipe, b) transport means for moving the spray unit through the pipe, c) means for supplying the coating material to the spray unit, whereby the means mentioned under b) are embodied as a relatively stiff tube (14) which is initially wound on a drum (38) or reel and is guided by guide means to an injector unit which forces the pipe in the one or in the other direction, and whereby the end of the tube has coupling means to connect the tube to the spray unit.



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System for coating the inner wall of tubes.

The invention relates to a system for coating the inner wall of tubes. This
5 system comprises

- a) a spray unit for spraying the coating material onto the inner wall of the tube,
- b) transport means for moving the spray unit through the tube,
- c) means for supplying the coating material to the spraying head.

10 **Prior Art**

A. Systems for coating pipes, tunnels etc.

Systems for applying a coating onto the inner wall of a pipe, tunnel, conduit etc.
are known as such from the prior art.

15 A first example is described in EP0667188. This system comprises an external
unit with storage tanks for the components of the coating, a reel or drum onto which a
tube is wound and an internal spray head which during operation will move through
the pipe to be coated. The tube, which is wound on the reel, has a number of internal
channels each through suitable couplings connecting one of the reservoirs with a
20 mixing chamber in the spray head.

Before starting operations the system has to be prepared. To start with an auxil-
iary line is brought in the pipe such that the line extends from a first entrance to a sec-
ond entrance. The external unit is installed above the first entrance. The tube is drawn
off from the reel, connected to the respective end of the auxiliary line and by means of
25 said line drawn through the pipe. After the end of the tube has reached the second en-
trance the line is disconnected and the spray head is installed. Thereafter the pumps
are started for pumping the components of the coating through the channels in the
tube to the spray head where they are received, mixed in the mixing chamber and
sprayed out into the direction of the pipe wall. Not only the pumps are switched on,
30 also the reel drive motor is switched on to slowly rotate the reel so that the tube is
drawn back causing the spray head to slowly move through the pipe. In this manner
the coating material is sprayed on the wall of the pipe along the whole length of the
pipe between the two entrances. Assuming that after mixing the two components only

a very short hardening time is necessary the mixture will adhere easily to the pipe wall form a coating thereon.

Another embodiment is described in GB1591409. In this case the spray head is installed on a carriage which is movable through the pipe to be coated. The carriage
5 can be drawn through the pipe by means of a pulling cable (in the manner described above) or can move through the pipe by means of electric motors driving various wheels of the carriage. In the same manner as described above a tube is drawn of from a reel and is connected to the spray head. The components of the coating are supplied through channels in the tube from storage tanks on the surface. For operation of this
10 system also two entrances to the pipe to be coated are necessary, one at either end of the pipe section to be coated. First a drawing cable is drawn through the pipe. Then the drawing cable is used to draw the carriage with the thereto-connected tube through the pipe, after which the system is ready for operation. By slowly winding the tube on the drum or reel the carriage with the active spray head is drawn through the pipe
15 leaving behind a coated pipe wall.

In the embodiment wherein the carriage is propelled by electric motors the operation can be performed using only one entrance. The carriage is placed in the pipe and is brought in motion whereby the driving force has to be sufficient to draw not only the supply tube but also an electric power cable (for powering the motors)
20 through the tube.

A further embodiment of a spraying installation for lining pipes is described in WO8804387. Together with a pulling line hose means are drawn through the whole length of the respective pipe section between two entrances to the pipe and laid along the bottom of the pipe. The hose means are filled with a predetermined quantity of
25 settable lining composition. A centrifugal lining machine is advanced along the length of the hose, thereby slitting the hose in front of the advancing centrifugal lining machine to permit egress of the lining composition from the hose and delivering the admixed settable composition to a centrifugal impeller of the centrifugal lining machine for application of the settable composition to the pipe wall as the centrifugal
30 lining machine advances along the pipe. The pulling line is used to pull said machine along the whole length through the pipe to be coated.

Another prior art embodiment is known from EP0094819. This installation sprays a one component coating of tixotropic resin onto the inner walls of the pipe. As

in the other discussed installations the spraying device in this system is also drawn by means of an auxiliary line from the first to the second entrance and by means of the supply tube back from the second to the first entrance.

Further embodiments of lining apparatuses can be found for instance
5 DE19841891 and US3966389 which will not be described in detail.

All the above mentioned prior art systems have the common disadvantage that two entrances to the pipe to be coated are necessary, one at the first end and one at the second end of the respective pipe section because before starting operation a pulling wire or line has to be brought in the pipe from the first to the second end thereof. In
10 none of the prior art publications data is provided about the way the auxiliary pulling line is brought into the pipe.

Under practical conditions these systems can be used only over relatively short distances. EP0667188 indicates 100 - 150 m, WO8804387 mentions 100m as example and EP0094819 indicates "more than 100 meters".

15 Only the embodiment in which a self-propelled carriage is used can operate with only one entrance. However, the fact that a rather complicated carriage has to be used is considered a disadvantage and furthermore also in this case the length of the pipe to be coated is still restricted because the rather small carriage has to drag the supply tube and the power cable through the pipe. These small carriages are not able
20 to do that over longer distances than 50 to 100 meters.

B. Coiled Tubing.

From the prior art a technique is known for performing operations in a pipe, tube, tunnel etc. which needs only one entrance to said pipe, tunnel etc. This
25 technique indicated as the "coiled tubing" technique is mainly used in combination with oil or gas wells or boreholes for other purposes. Coiled tubing is a continuous length flexible product, in many cases but not exclusively, made from steel. Originally steel strip is progressively formed into a tubular shape and a longitudinal weld is made by suitable welding techniques. In more recent years tubing made of
30 composite materials is developed. The length of such a coiled tubing can be several thousand meters. The coiled tubing is typically mounted on a reel, which is carried to and from the operating site on a truck. In use the coiled tubing is fed off the reel, over a gooseneck and into the well through a coiled tubing injector. This bends the tubing

thereby creating severe fluctual strains and plastic deformation of the tubing. Through the injector the tube can be pushed forwards (into the borehole) or can be drawn backwards (out of the borehole). More information about the coiled tubing technique can be found in e.g. US5853118, US5803168, US5799731, EP0953724, and
5 WO9859149.

Information about suitable tubes made from composite materials can be found in US5921285.

Although the majority of gas and oil wells runs mainly vertical there also are wells which are extending partly horizontal or nearly horizontal, in any case not
10 strictly vertical. Examples thereof can be found for instance in US5704393, GB2338010, WO9859149. In case a coiled tubing is lowered down into a vertical well the own weight of the coiled tubing will add the lowering operation. This advantage is eliminated if it comes to horizontal well sections. However, in practice has coiled tubing functions properly also in non-vertical well sections. That proves the
15 significant pushing power which can be developed by coiled tubing. In fact coiled tubing provides a tremendous pushing and pulling power which can be controlled very accurately. It is known to use coiled tubing for drilling, logging, perforating, fishing, running packers and other operations to be performed in an oil or gas well. Through the tube material, power, electricity and/or data can be supplied to the tool,
20 such as gasses or fluids which are necessary during the operations. Through these gasses or fluids furthermore pneumatic signals can be transferred to the tool to control said tool which is in the meantime somewhere within the pipe or tube. The control can be performed also through electrical signal conduits which are extended through the hose or are embedded in the wall of the hose.

25

The Invention

An object of the invention is now to improve the system described in the first paragraph of this specification such that the system can be used with only one
30 entrance to the pipe to be coated and such that significantly longer pipe sections can be treated.

In agreement with said object the invention now provides a system for coating the inner wall of cubes, hoses, tunnels etc., comprising:

- a) a spray unit for spraying the coating material onto the inner wall of the pipe,
b) transport means for moving the spray unit through the pipe,
c) means for supplying the coating material to the spray unit, whereby the means mentioned under b) are embodied as a relatively stiff tube which is initially wound on a drum or reel and is guided by guide means to an injector unit which forces the pipe in the one or in the other direction, and whereby the end of the tube has coupling means to connect the tube to the spray unit.

Figures

10

The invention will be explained in more detail with reference to the attached drawings in which two embodiments of a system according to the invention are schematically drawn in more detail

15 Detail description

In figure 1 the coiled tubing apparatus is in general indicated by 10. This apparatus comprises on the one hand a reel with a hose or tube 14 from a relatively stiff material which is bound on said reel. This hose 14 is pushed into the tube 20 to be coated by means of a pushing unit 16, in general indicated as the injector. The tube is for instance laid within the ground at a certain depth. In the figure the ground level is indicated by 22. Between the near and off the tube 20 (or the section of the tube which is specially opened for this purpose) and a certain point above the ground level a bended guiding tube 24 is installed. The injector 16 is positioned under a certain angle that the tube, pushed by said injector, can be conducted in the correct direction by said conducting tube 24 so that the hose without much resistance becomes inserted into the tube 20 to be coated. Before the hose 14 after leaving the injector 16 is entered into the guiding tube 24 preferably centring elements 26 are attached to at least the front end of the hose, so that at least the first section of the hose is centred within the tube 20. In figure 1 there of these centre elements are indicated by 26a, 26b, 26c.

The components described up to now are known as such. For further details the attention is drawn to the patents and other publications which are related to coiled tub-

ing systems. On the front end of the hose 14 a tool can be installed. Within the scope of the invention the front end of the tube 14 is connected to a spraying head 30.

Although various types of spraying heads can be used the invention is especially directed onto spraying heads by means of which a coating layer made from two or
5 more components can be sprayed under the wall of the tube 20. This spraying head is preferably of a type which is described in detail in the Dutch application NL1011562. For further details the attention is drawn to the contents of said Dutch application.

Using this spraying head a number of components, from which the coating is formed, are mixed and sprayed onto the inner wall of the tube 20. As soon as the mix-
10 ture is formed the hardening process will start which process will take place so fast that the mixture, as soon as it is sprayed onto the wall of the tube, does not show any further movements and forms directly a clean continuous coating.

The components from which the coating is formed are supplied through conduits to the spraying head 30. These conduits, one of which being indicated in the
15 figure by 32, are connecting the storage reservoirs such as 34 and 36 with the spraying head 30. In the embodiment in the figure the hose 32 is wound off from a reel 38. Through a coupling 40 in the central section of the reel and a connection 42 between said coupling and the reservoir 34 the component, which is stored in the reservoir 34 can be guided to the spraying head 30. In a similar manner more components can be
20 supplied from a respective reservoir to the spraying head 30.

The hoses 32 are between the injector 16 and the guiding tube 24 attached to the hose 14 and are therefore conveyed together with said hose 14.

In figure 2 another possible embodiment of a system according to the invention is illustrated. The components 10 until 30 are identical to the components with the
25 same reference number in figure 1 and therefore do not need further explanation. In this embodiment it is assumed that the hose 14 has internally a number of channels as is indicated schematically in the cross section of figure 3. The three illustrated channels are in figure 3 indicated by 44a, 44b and 44c. The reel in this case has one central connection 46 from which three conduits 48a, 48b and 48c are extending to
30 three reservoirs 50a, 50b and 50c. In these reservoirs the components are stored for the coating which has to be sprayed under the wall of the tube 20. The coupling 46 is of the type which incorporates three (or more) connections between the conduits 50 and the channel 44 in the hose 14.

It will be clear that the illustrated embodiments are only very schematically shown although in so much detail that it is clear to the expert in this field how such a system can be realised in practice.

It is known to use coiled tubing for drilling, logging, perforating, fishing,
5 running packers and other operations to be performed in an oil or gas well. Through the tube material, power, electricity and/or data can be supplied to the tool, such as gasses or fluids which are necessary during the operations. Through these gasses or fluids furthermore pneumatic signals can be transferred to the tool to control said tool which is in the meantime somewhere within the pipe or tube. The control can be
10 performed also through electrical signal conduits which are extended through the hose or are embedded in the wall of the hose.

The spraying unit in the above mentioned system according to the invention can be any spraying head . However, some types are to be preferred. such as described in DE19822301.

15 In case there are no centring means in the coiled tubing apparatus then it is preferred that the system comprises furthermore means for centring the spraying head within the tube to be coated.

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CLAIMS

1. System for coating the inner wall of a pipe, a tunnel etc., comprising:
 - 5 a) a spray unit for spraying the coating material onto the inner wall of the pipe,
 - b) transport means for moving the spray unit through the pipe,
 - c) means for supplying the coating material to the spray unit, whereby the means mentioned under b) are embodied as a relatively stiff tube which is initially wound on a drum or reel and is guided by guide means to an injector unit which forces the pipe
10 in the one or in the other direction, and whereby the end of the tube has coupling means to connect the tube to the spray unit.

2. System according to one of the preceding claims, **characterised in that** the system comprises furthermore:
 - 15 d) means for centring the spray head within the pipe or tunnel to be coated.

3. System according to one of the preceding claims, **characterised in that** the system comprises furthermore conduits between the spray unit and reservoirs which are positioned outside the pipe or tunnel to be coated, which reservoirs store the
20 components which together are forming the coating.

4. System according to claim 3) **characterised in that** said conduits are extending through said relatively stiff tube.

Fig 1

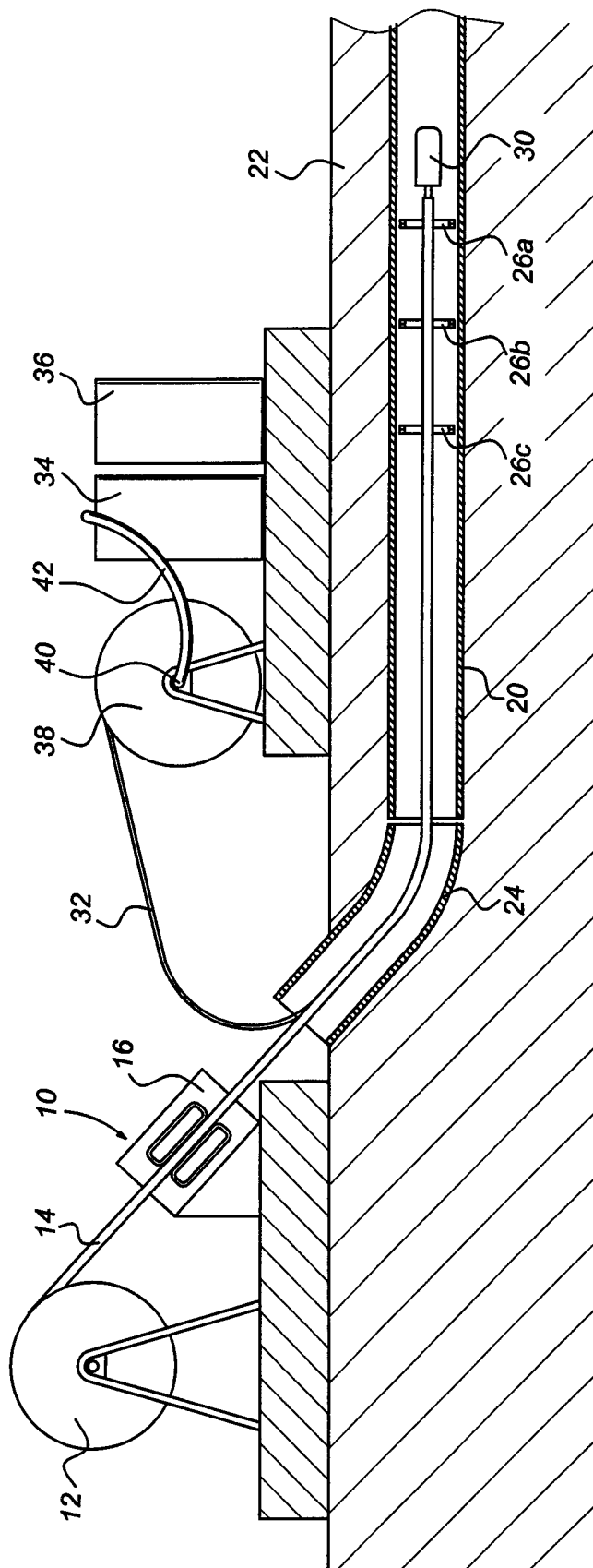


Fig 3

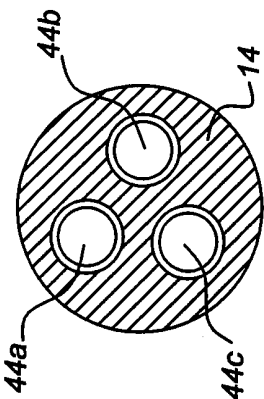
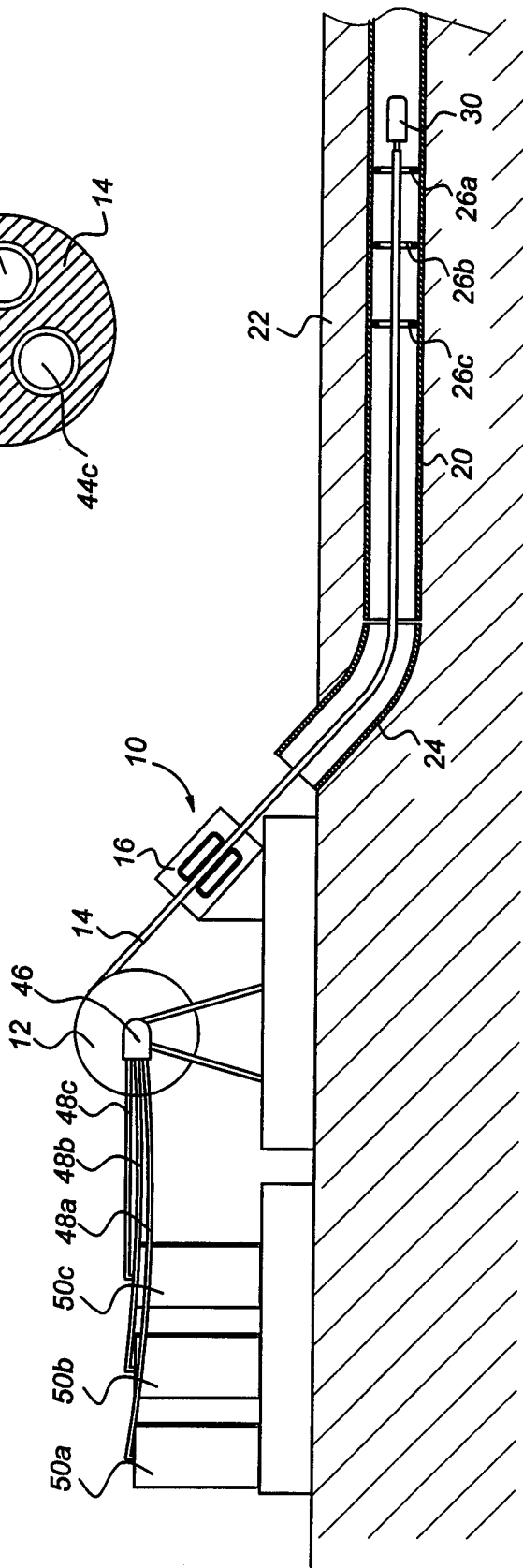


Fig 2



INTERNATIONAL SEARCH REPORT

International Application No

PCT/NL 00/00514

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 B05B13/06

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 B05B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

PAJ, WPI Data, EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	EP 0 667 188 A (ERNEST RYSER SARL ETS) 16 August 1995 (1995-08-16) cited in the application column 5, line 10 - line 38 ---	1,3,4
Y	WO 91 11270 A (BHR GROUP LTD) 8 August 1991 (1991-08-08) page 4, line 11 ---	1,3,4
A	GB 1 591 409 A (SIARGAS) 24 June 1981 (1981-06-24) cited in the application page 2, line 42 - line 58 -----	2

Further documents are listed in the continuation of box C.

Patent family members are listed in annex.

° Special categories of cited documents :

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

- "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- "&" document member of the same patent family

Date of the actual completion of the international search

1 November 2000

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INTERNATIONAL SEARCH REPORT

...formation on patent family members

International Application No

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