

PATENT SPECIFICATION

DRAWINGS ATTACHED

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COMPLETE SPECIFICATION

Method and apparatus for the manufacture of Pipe

We, **JOHNS-MANVILLE CORPORATION**, a corporation organized under the laws of the State of New York, United States of America, of 22 East 40th Street, New York 16, State of New York, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to method and apparatus for the manufacture of asbestos-cement pipe formed on a mandrel from a wet asbestos-cement pulp or stock. More specifically, the invention is directed to method and apparatus for the manufacture of asbestos-cement pipe which includes the loosening of the wet cementitious pipe from the mandrel.

The conventional method of manufacturing asbestos-cement pipe involves winding a wet sheet of asbestos-cement pulp on a rotating, hollow mandrel while applying high pressure thereto. When a pipe of suitable wall thickness has been formed, the mandrel is removed from the pressure applying means and the formed pipe is then removed from the mandrel for curing. Because of the high pressure applied during the winding of the sheet stock on the mandrel, a firm bond develops between the pipe and the mandrel and it is necessary to break this bond to permit the removal of the wet asbestos-cement pipe from the mandrel without detrimental damage to the pipe.

Many attempts have been made to devise a method of loosening the formed pipe from its mandrel without distorting the pipe or cracking or otherwise damaging its inner surface. Generally, the systems developed, while generally acceptable for a commercial operation, are not completely satisfactory since it is necessary to utilize additional apparatus, separate from that on which the pipe is formed, to loosen the pipe from the mandrel. Besides the additional apparatus, there is required an extra operation

in the manufacture of the pipe. Also, the use of the additional apparatus necessitates a time interval between the formation of the wet pipe and the loosening operation and since the pipe in many instances includes a very fast setting cement, this time interval may allow the material in the pipe to set partially and thus make loosening difficult.

It is an object of the present invention to provide method and apparatus for the manufacture of pipe including the loosening of the pipe during the manufacturing thereof from the mandrel on which it is formed.

In brief, the invention provides for a method of manufacturing a fibrous-cement pipe, such as an asbestos-cement pipe, which is electrically conductive in a wet state and which is formed under pressure by being wound from a sheet as laminations on a rotating mandrel having an electrically conductive surface, and utilizing an electric current preferably a direct current, to loosen the pipe from the mandrel, characterized in that the current is passed through the pipe and the conductive surface of the mandrel prior to the end of the forming cycle to loosen the bond between the pipe and the mandrel, and thereafter removing the loosened pipe from the mandrel; also preferably the current is applied for a plurality of revolutions of the mandrel during the last quarter portion of the forming time and the current is in a direction from the pipe to the mandrel surface.

The invention will be more fully understood and further objects and advantages thereof will become apparent when reference is made to the following detailed description and the accompanying drawing in which:

FIG. 1 is a side elevational view of a schematic illustration of apparatus to be used in accordance with the instant invention;

FIG. 2 is a sectional view taken on the plane passing through the line 2—2 of FIG. 1;

Fig. 3 is a side elevational view of a sche-

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matic illustration of another type of apparatus to be used in accordance with the instant invention, and

FIG. 4 is a sectional view taken on the plane passing through the line 4—4 of FIG. 3.

Referring to the drawing, there is illustrated in FIG. 1 conventional apparatus for forming a pipe on a mandrel and in the preferred embodiment of the invention comprises an anvil roll 2 over which there travels a felt 4 carrying a wet stock sheet 6 of asbestos, cement, water and other materials, which stock is deposited thereon by conventional apparatus (not shown) such as a cylinder mold or molds. The anvil roll 2 is a rigid element capable of withstanding pipe forming pressures without flexing, is mounted for rotation in fixed supports 8 and is rotated by conventional means (not shown) to drive the felt 4 in the direction indicated by the arrow. In the preferred embodiment of the invention, the anvil roll 2 comprises an electrically conductive material such as iron. Positioned above the anvil roll 2 is a press section 10 which is moved toward and away from the anvil roll 2 by mechanical means (not shown). A plurality of hydraulic means 12 are used to apply pressure to the pipe being formed as described below. In the preferred embodiment of the invention, the press section 10 comprises a heavy bar 14 secured to the hydraulic means 12 and having depending end portions 16 arranged to provide journals for the shafts 20 of two rows of press rolls 22. The depending portions 16 may each be formed of parts divided on a line bisecting shafts 20 and secured together by bolts 24. In the preferred embodiment, the rolls 22 are covered with a rubber-like material.

In the conventional manner of forming pipe with the above described apparatus, the press section 10 is moved away from the anvil roll 2 and a hollow steel mandrel 26 is placed on the anvil roll 2. The mandrel 26 is supported only by resting on the anvil roll 2. The press section 10 is moved toward the anvil roll 2 so that the mandrel 26 is between the anvil roll 2 and the press rolls 22. The anvil roll 2 is then rotated in a direction indicated by the arrows, causing movement of the felt 4 by the anvil roll 2. The wet stock sheet 6 on the felt will adhere to the mandrel 26 and will be wound upon the mandrel 26 as the mandrel is caused to rotate by the movement of the felt 4. The wet stock sheet 6 is then condensed thereon by the press rolls 22 and is bonded to the mandrel to form a pipe 28. In conventional machines, the press rolls 22 are arranged to exert pressures of from about 300 to 30 pounds per line inch (54 to 5.4 Kgs/centimeter) of pipe length. In forming asbestos-cement pressure pipe, the press section exerts about 300 pounds per line inch (54 Kgs/centimeter) of pipe at the beginning of the forming cycle and this pressure is gradually reduced during the forming cycle until it reaches about 150 pounds per line inch (27

Kgs/centimeter) of pipe adjacent the end of the forming cycle. In forming asbestos-cement sewer pipe, the pressures exerted by the press section on the wall of the pipe throughout the formation of the pipe are from about 100 pounds per line (17.8 Kgs/centimeter) of pipe at the beginning of the forming cycle to about 50 pounds per line inch (8.9 Kgs/centimeter) of pipe adjacent the end of the forming cycle. As a result of these pressures, a considerable amount of water is squeezed from the wet stock sheet 6 at the nip between the pipe 28 on the mandrel 26 and the anvil roll 2. The mandrel 26 is rotated until a plurality of laminations from the wet stock sheet 6 have been formed thereon.

In view of the high pressures exerted on the mandrel during the formation of the pipe thereon, it is conventional to form the mandrels from a material such as steel. Thus, in the preferred embodiment of the invention the mandrels 26 comprise a suitable steel which provides a continuous peripheral surface which is electrically conductive. However, it is to be understood that it is within the limits of the instant invention to construct the mandrel from any suitable type of material which can stand the pressures involved as long as the peripheral surface, or portions thereof, is electrically conductive.

In the embodiment of the invention illustrated in FIGS. 1 and 2, an electrode 30 is placed into electrical contact or electrical conducting relation with each end of the anvil roll 2 preferably by contacting the axle 32 of the anvil roll, which serves as an electrical conductor. The electrodes 30 are connected to any suitable means for moving them into contact with the axle 32 of the anvil roll such as the pivoted arms 33. A pair of electrodes 34 are mounted for movement into and out of contact with the free ends of the mandrel 26 by any type of conventional means such as the control mechanisms 36 secured to the press section 10. In the preferred embodiment of the invention, the electrodes 30 are connected electrically to the positive terminal of an electrical direct current source such as a D. C. generator of a rated value of 60 kilowatts and 350 volts and which can be regulated as desired, and electrodes 34 are connected electrically to the negative terminal of the same electrical direct current source. A conventional switch (not shown) is utilized to complete the electric circuit. The anvil roll 2, through the electrically conductive supports 8, is connected electrically to ground 38 while the press section 10 is insulated electrically from the machine frame such as by the rubber-like material on the peripheral surfaces of the press rolls 22. Also, the supports for the electrodes 34 are insulated electrically from the machine frame.

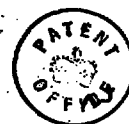
In accordance with the instant invention the material from which the pipe is formed and the conveyor belt are electrically conductive.



cycle

- In the preferred embodiment of the invention, the material for forming the pipe comprises a wet stock sheet comprising asbestos, hydraulic cement and water. Because of the physical and chemical composition of this wet stock sheet, it is electrically conductive. When the wet stock sheet passes between the mandrel and the anvil roll while the press rolls are exerting pressure thereon, considerable adulterated water is pressed from the wet stock sheet and saturates the conveyor belt. The physical and chemical characteristics of this adulterated water make the conveyor belt at this point electrically conductive.
- 15 When it is desired to loosen the pipe 28 from the mandrel 26, the electric circuit is completed and an electric direct current flows

from the anvil roll 2, through the conveyor belt 4, the wet stock sheet 6 and the pipe 28 to the mandrel 26. The amount of voltage supplied by the electrical direct current source, the current flowing through the circuit and the time during which the current flows vary with the forming time, the diameter, the wall thickness and the density of the pipe and the type of material in the pipe. Also, even when making the same type of pipe and applying the same voltage to the circuit, the current passing through the circuit may vary because of the physical and electrical characteristics of the materials in the pipe. The data in the following table was obtained from tests conducted during the manufacture of various sizes and types of asbestos-cement pipe:



manufacture

TABLE J

Pipe	Form Time at Felt Speed (Sec.)	Mandrel (Rev./Sec.) 80'/min.	Felt Speed (Ft./Min.)	Loosener		Loosener Application		Remarks
				Voltage (Volts)	Current (amps)	Start (*)	End (Sec.)	
(30.5 cm) 12" Class 3300	81.0	0.38	108 (54.8	210	255	51.0	81.0	Too loose
"	81.0	"	" cm/sec	180	260	58.0	81.0	Loosened O.K.
12" Class 1500	81.0	"	"	Nothing				Couldn't pull
"	90.0	0.38	84 (60.4	175	250	65.0	90.0	Loosened O.K.
"	90.0	"	" cm/sec	Nothing				Couldn't pull
"	90.0	"	"	175	210	73.0	90.0	Loosened O.K.
"	90.0	"	"	175	200	82.0	90.0	Loosened O.K.
"	69.0	"	98 (51.8	240	160	54.0	69.0	Loosened O.K.
"	69.0	"	" cm/sec	240	140	54.0	69.0	Loosened O.K.
"	69.0	"	"	Nothing				Loosened O.K.
(25.4 cm) 10" Class 1500	60.0	0.45	"	225	230	52.0	60.0	Couldn't pull
"	60.0	"	"	225	280	52.0	60.0	Loosened O.K.
(40.6 cm) 16" Class 3300	145.0	0.39	95 (53.4	Nothing				Loosened O.K.
"	145.0	"	" cm/sec	110	160	30.0	40.0	Couldn't pull
"	145.0	"	"	110				Pipe blown
"	145.0	"	"	110	160	125.0	135.0	from mandrel
"	145.0	"	"	110	160	115.0	125.0	Loosened O.K.
10" Class 150	145.0	"	"	110	160	110.0	145.0	Loosened O.K.
"	97.0	0.43	"	130	210	92.0	97.0	Loosened O.K.
"	97.0	"	"	Nothing				Couldn't pull
"	97.0	"	"	130	210	76.0	97.0	Loosened O.K.
"	95.0	"	"	135	260	80.0	95.0	Loosened O.K.

* The numbers in these columns represent the time in seconds from the beginning of the forming cycle.

The foregoing examples clearly show that the system described in the instant application functions to loosen successively the bond between the mandrel and the pipe so that the mandrel can be pulled from the pipe. Also, the examples show that without such loosening, the mandrel cannot be pulled from the pipe. These examples also illustrate the wide ranges relative to the types of pipe, the amount of voltage and current, the time the voltage is applied, and the period when the voltage is applied involved in effecting a loosening of the bond between the mandrel and the pipe. Generally, it is preferred to apply the voltage during the last quarter portion of the forming cycle as indicated by columns 7 and 8 of Table I. In some instances, the voltage and current were too great or applied too early and resulted in loosening the pipe too much. This resulted in pipe that was not acceptable because their dimensions were outside of the tolerances allowed. In other instances, the current was not applied long enough or at the proper period of time and therefore, the bond between the mandrel and the pipe was not loosened. However, the tests which produced the results shown by these tables establish that the system disclosed herein will loosen successfully the bond between the pipe and mandrel so that the mandrel may be pulled from the pipe with no serious damage to the pipe. When it is desired to use the system of the instant invention in the manufacture of a particular type of pipe, the various practical limits effecting the loosening of the bond between the mandrel and the pipe may be readily determined. It is understood that the foregoing examples are given for illustration purposes only and that the invention is not to be limited thereto.

The apparatus illustrated in FIGS. 3 and 4 is generally similar to the apparatus of FIGS. 1 and 2, and the corresponding parts have been similarly numbered. In FIGS. 3 and 4, the mandrel 26 is mounted for rotation in either one of the journals 40 which are pivotally mounted on the supports 8 for movement about an axis generally perpendicular to the axis of the anvil roll 2. As illustrated in FIG. 4, one end of the mandrel has been inserted into one of the mandrel clamping jaws 41 in each of the journals 40 and has been swung into pipe forming position between the press rolls 22 and the anvil roll 2 while the other journal, which at that time does not participate in supporting the mandrel already in the pipe forming position, is in position to receive a new mandrel. Also, the journals 40 are designed for vertical reciprocal movement to allow for different diameters of mandrels and for the formation of the pipe on the mandrel 26. It is to be understood that the journals 40 and associated structures therewith are portions of conventional machines which have only been illustrated schematically in the instant invention since their particular structure forms no part of the

instant invention. In the apparatus illustrated in FIGS. 3 and 4, the mandrel 26 through the journal 40 which is supporting it and through supports 8 is connected electrically to ground 38 while the anvil roll 2 is insulated electrically from ground such as by electrical insulation 42. Therefore, the electrodes 30 are positioned on the anvil roll 2 with the insulation 42 between the electrodes and the supports 8. As in the apparatus in FIGS. 1 and 2, the electrodes 30 are connected to the positive terminal of an electrical direct current source (not shown) and the electrodes 34 are connected to the negative terminal of said electrical direct current source. Except for this relative change in ground connection, the insulating from ground of the anvil roll and the different manner of supporting the mandrel, the apparatus of FIGS. 3 and 4 functions in every respect similar to the apparatus described in FIGS. 1 and 2.

In the preferred embodiment of the invention, the anvil roll is connected to the positive terminal of an electrical direct current source and the mandrel is connected to the negative terminal of the electrical direct current source. While it may be possible to loosen pipe from mandrels using other types of electrical circuits, experience has demonstrated that because of many factors, including particularly the physical characteristics of the standard mandrels, it is preferable with the production equipment presently in use to employ an electrical direct current flowing as described above in the preferred embodiment of the invention for effecting the loosening of the wet asbestos-cement pipe from the mandrel. However, if an advancement in the art brings about a change in mandrels, it would be within the scope of this invention to use direct current flowing in a direction from said mandrel to said pipe or low frequency square wave alternating current to effect the loosening of the pipe from the mandrel.

The method and apparatus of the instant invention have functioned remarkably well to loosen the bond between the mandrel and the wet pipe. While the exact reason for this improvement is not known, there are factors associated with the instant invention which are not present in other types of electric loosening. For instance, there is associated with the loosening a new type of calendering action since the wet pipe during the loosening action is subjected to the extremely high forming pressures, described above as being of a nature of about 300 to 50 pounds per line inch (54—8.9 Kgs./centimeter) normally associated only with the formation of the pipe. Another reason is associated with the water which is present at the nip between the anvil roll and the wet pipe while the pressure is being exerted on the pipe wall. In this condition the pipe wall is in its most condensed and most saturated condition and probably offers its lowest resistance against electrical current flow. Also, the adulterated

In order to test the effectiveness of the method and apparatus of the instant invention, a special test run was made. The peripheral surface of ten conventional mandrels were shot

Based on the formation of the tight bond between the mandrel and the wet pipe in the manufacture of pipe as described above. Pipes of the type identified as 12 inches (30.5 cm) Class 1500 were then formed on these mandrels and subjected to three different types of loosening, i.e., knifing, roll type electric loosening and the electric loosening of the instant invention. The results of these test are given in the following table:

TABLE II

Type of Loosener	Form Time (Sec.)	Mandrel (Rev./Sec.) 80'/min.	Felt Speed (Ft./Min.)	Loosener Voltage (Volts)	Loosener Current (Amps)	Application Total Time (Sec.)	Effective Loosening
Instant Inv.	84	0.38	98 (51.8 cm/sec)	225	300	8	Yes (No mushroom)
Instant Inv.	84	"	98	225	300	8	Yes (No mushroom)
Roll	84	"	98	250	110	20	No (Couldn't pull)
Roll	84	"	98	248	110	30	No (Couldn't pull)
Knife	84	"	98				No (Couldn't pull)
Instant Inv.	84	"	98	225	280	10	Yes (No mushroom)
Instant Inv.	84	"	98	225	270	7	Yes (No mushroom)
Knife	84	"	98				No (Couldn't pull)
Roll	84	"	98	245	100	30	No (Couldn't pull)
Roll	84	"	98	240	120	30	No (Couldn't pull)

These results clearly demonstrate the advantages of the electric loosening of the instant invention. The pipe subjected to the knifing and roll type electric loosening could not be pulled from the mandrels while the pipe loosened in accordance with the disclosure in the instant application were pulled from the mandrels with no damage to the pipe.

The method and apparatus of the instant invention function to effect a more uniform loosening of the pipe from the mandrel along the entire length and circumference of the pipe. This allows for the formation of a very tight pipe, i.e., one that is very close to the actual outside configuration of the mandrel. Also, this uniform loosening of the pipe allows for the pulling of the pipe from the mandrel with a minimum of force so that there is little or no mushrooming of the pipe end. Also, the pipe itself will be more round and have smoother interiors than pipe loosened with other types of loosening methods and mechanisms. Because of the added advantages set forth above, the use of the invention will substantially reduce the number of rejects and might possibly eliminate all rejects based on incomplete or excessive loosening of the pipe from the mandrel.

WHAT WE CLAIM IS:—

1. A method of manufacturing a fibrous-cement pipe such as an asbestos-cement pipe which is electrically conductive in a wet state and which is formed under pressure by being

wound from a sheet as laminations on a rotating mandrel, the latter having an electrically conductive surface, wherein an electric current, preferably a direct current, is passed through the pipe and the conductive surface of the mandrel prior to the end of the forming cycle to loosen the bond between the pipe and the mandrel, and thereafter removing the loosened pipe from the mandrel.

2. A method of manufacturing a fibrous-cement pipe as recited in claim 1, wherein the electrical current is applied for a plurality of revolutions of the mandrel.

3. A method of manufacturing a fibrous-cement pipe as recited in either claim 1 or 2, wherein the electrical current is applied during the last quarter portion of the forming time on the mandrel.

4. A method of manufacturing a fibrous-cement pipe as recited in either claims 1, 2, or 3 wherein the current flows from a direction from the pipe to the mandrel surface.

5. Apparatus for effecting the method of either claims 1, 2, 3, or 4.

6. An asbestos-cement pipe produced by the method of any one or more of claims 1—4 or the apparatus of claim 5.

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5. Apparatus for effecting the method of either claims 1, 2, 3, or 4.

6. An asbestos-cement pipe produced by the method of any one or more of claims 1—4 or the apparatus of claim 5.

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