PATENT EXAMINATION BOARD

PRACTICAL LEGAL PROBLEMS – GROUP 2(f)

[PAPER 1]

JULY 2024

Examiners: J Whittaker
D Dohmen

Moderator: R Bagnall

Time: Reading Time - **1 Hour**
Examination Time - **4 Hours**
Total - **5 Hours**

Total Marks: 100

This paper consists of 6 pages (including this cover page) and includes three questions.

This paper also includes four annexures, namely:

(i) Annexure A – Letter of demand (1 page);

(ii) Annexure B – ZA 2018/05478 (9 pages);

(iii) Annexure C – US 2005/0015986 A1 (6 pages); and

(iv) Annexure D – WO 2015/010158 A1 (9 pages).

Instructions:

- Answer all three questions; and
- Write legibly.

NOTES TO CANDIDATES:

1. Attached to this paper are copies of the following documents:

   (i) A copy of the Patents Act No. 57 of 1978;

   (ii) A copy of the Patent Regulations 1978; and

   (iii) A copy of the Uniform Rules of the High Court under the Superior Courts Act 10 of 2013 (Rules 6, 14, 17, 18, 19, 21, 22, 23, 24, 25, 30, 35, 36 and 37).

2. Each candidate is also allowed access to one dictionary during the Exam.

3. Prior to the handing out of the answer papers, candidates will have an opportunity to read the above documents and make notes for 60 minutes.

4. Where appropriate, reference should be made to case law, and conclusions should be supported by reasons and arguments.

Your client writes to you as follows:

“Dear Patent Attorney,

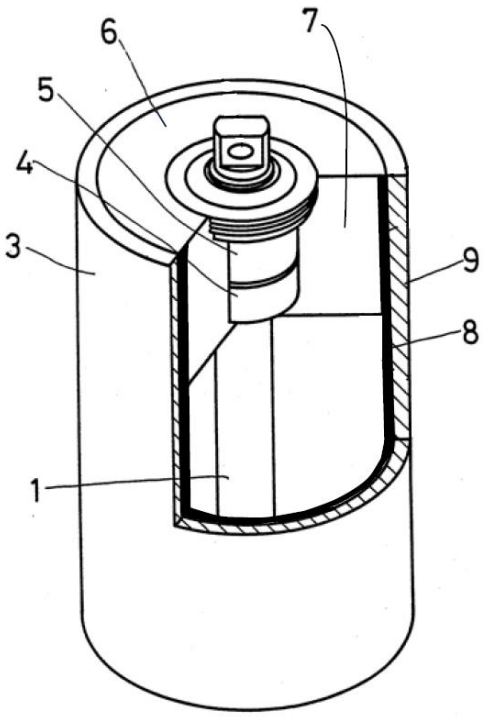
I am the managing director of a company, MiningE (Pty) Ltd, which manufactures and sells mining equipment. We have been manufacturing and selling belt conveyor rollers in various forms for more than two decades. Our rollers are designed for use in bulk material handling conveyors for transporting large volumes of heavy, abrasive and granular materials, such as coal and ore, in mining applications.

As you may know, these types of belt conveyors include an endless belt which forms a continuous loop extending over rotating rollers at either end of the conveyor. At least one of these rollers is powered to rotate the belt. Usually, electric motors are used, operating through constant- or variable-speed reduction gears, to drive the powered rollers. The belt is drawn over a plurality of unpowered, rotating idler rollers between either end of the conveyor which serve to provide further support to the belt and its load.

The rollers of belt conveyors are inherently susceptible to frictional wear from the moving belt. This is especially the case with bulk material handling conveyors used in mines, where abrasive material between the rollers and the belt increases the friction between these components. Excess wear in a roller during use can cause it to crack, splinter and fail, resulting in costly, unscheduled downtime for the repair of the failed roller. If the failed roller causes damage to the belt and/or other equipment, this can result in further delays and cost.

Last year, we designed a new belt conveyor roller, and a drawing of our roller appears on the next page.

The roller comprises a drum 3 rotatably supported on a shaft 1 by a bearing assembly 4, 5 and 7 at each end of the shaft. The drum 3 includes a tubular inner sleeve 8 and a co-axial tubular outer sleeve 9. The inner sleeve 8 is formed from polyurethane and has high tensile strength and a relatively lightweight construction. The outer sleeve 9 is formed from ultra-high molecular weight polyethylene (UHMWPE) and has high wear resistance.



Importantly, a colour additive is added to the polyurethane forming the inner sleeve 8 so that this sleeve has a bright yellow colour, and a colour additive is added to the UHMWPE forming the outer sleeve 9 so that this sleeve is navy blue in colour. This allows the drum 3, when worn, to reveal the bright yellow inner sleeve 8, in contrast to the navy blue outer sleeve 9. This contrasting colour difference allows an operator to monitor the wear of these rollers without having to stop the conveyor belt. When the operator sees the colour yellow on one of the rollers, this indicates that that roller has become worn and requires replacement. We market our new roller under the name “ColourThru”.

The drum 3 is manufactured by co-extruding the inner sleeve 8 and the outer sleeve 9. Subsequently, the co-extruded drum 3 is secured to the shaft 1 via the bearing assemblies, and an end cover 6 is attached to each end adjacent each bearing asembly.

About a year ago, we started selling our ColourThru roller to mines in South Africa, and the feedback was very positive. Within a few months we were supplying large volumes of our new roller to several mines, and it became necessary for us to extend our manufacturing facility to meet the growing demand for this product. Based on our sales figures, our ColourThru roller has become one of our leading products.

However, yesterday I received a lawyers' letter threatening legal action against MiningE unless it complies with certain demands, including that MiningE immediately stops manufacturing and selling the ColourThru roller. In the letter, the lawyers state that MiningE has infringed South African patent 2018/05478 which belongs to their client, Roller King (Pty) Ltd. A copy of the letter is attached marked "**Annexure A**", and a copy of the specification of the South African patent is attached marked "**Annexure B**".

Since the ColourThru roller has become a successful product for our business, it is important for MiningE to continue manufacturing and supplying this product in South Africa.

Please advise us as to our position and the best way forward.

Yours sincerely,

Peter Bush
MiningE (Pty) Ltd"

You conduct some background checks and establish that:

(a) ZA 2018/05478 was filed on 11 August 2018 claiming priority from an earlier South African patent application which was filed on 15 November 2017;

(b) All formalities in respect of ZA 2018/05478 were correctly complied with; and

(c) ZA 2018/05478 is currently in force.

Pursuant to a prior art search, you locate:

(i) US 2005/0015986 A1 [**Annexure C**]; and

(ii) WO 2015/010158 A1 [**Annexure D**].

QUESTION 1 **(35 marks)**

Please provide your client with detailed advice on whether or not the manufacture and sale by MiningE of the ColourThru roller in South Africa amounts to infringement of the claims of ZA 2018/05478.

QUESTION 2 **(35 marks)**

Please provide your client with detailed advice on the validity of the claims of ZA 2018/05478 in light of the prior art.

QUESTION 3 **(30 marks)**

In light of your answers to questions 1 and 2 above, please advise your client on the best way forward, and prepare a response to the letter of demand [**Annexure A**].

ANNEXURE A

LETTER OF DEMAND

Awful Attorneys, Inc.
PRETORIA

MiningE (Pty) Ltd
Johannesburg

Our Ref: LIT 054
Date: 28 June 2024

Dear Sirs

Infringement of South African Patent 2018/05478

We write to you on behalf of our client, Roller King (Pty) Ltd, the proprietor of the above South African patent.

A copy of the patent specification is attached.

The patent is in full force and effect and our client relies upon it for the protection of its rights.

We are advised by our client that you are manufacturing and selling a conveyor roller under the name "ColourThru" which falls within the scope of the patent. We have been provided with one of your ColourThru rollers, from which it is clear that your product ("**the infringing product**") falls within the scope of at least claim 1 of the patent. As such, we have been instructed to demand from you, as we now do, that:

1. You immediately stop manufacturing, offering for sale and/or selling the infringing product;

2. You hand over to us under oath for destruction all infringing products still in your possession or under your control;

3. You furnish our client with a written undertaking not to infringe its patent rights again in the future;

4. You pay our client such damages as may be due; and

5. You pay our client's legal costs.

If we do not receive compliance with the demands set out above within two weeks of the date of this letter, we hold instructions to institute legal proceeding against you without further notice to you.

Yours faithfully

Awful Attorneys, Inc.

CONVEYOR ROLLER CASING

BACKGROUND

The present invention relates to conveyor rollers, and in particular to an outer casing for a conveyor roller.

Conveyor systems are used to transfer materials from one location to another. For example, belt conveyors are widely used to transport different materials in various applications, such as in construction, mining, agriculture, and general manufacturing. These conveyors include an endless conveyor belt that travels over a series of supporting, rotatable rollers or idlers to convey material on the belt. Typically, the rollers are supported adjacent the conveyor belt in roller frames.

These types of rollers usually include an outer roller casing which is rotatably secured to an inner shaft by means of bearings supported in end caps at each end of the shaft.

Historically, rollers have been made from steel. In applications with relatively high loads and wear, these rollers need to be robust and tend to be relatively heavy. Handling such rollers during repair or replacement is difficult, especially when access to such rollers is limited by the positioning of adjacent roller frames.

Roller casings formed from other materials such as, for example, plastics materials are also known. Rollers with these roller casings may be relatively lightweight, making them easier to handle than steel rollers during repair or replacement. However, in applications with relatively high loads and wear, there are difficulties in ensuring that a lightweight outer roller casing is sufficiently strong to withstand the loads in use, and sufficiently hard wearing to ensure durability.

In addition, it is desirable for such a lightweight outer roller casing to include means for indicating when it is worn and requires replacement.

In view of the above, it is an object of the present invention to provide a conveyor roller casing which is formed from plastics materials, and which is relatively strong and durable.

It is a further object of the invention to provide a conveyor roller casing which, when worn, indicates clearly that it requires replacement.

SUMMARY OF THE INVENTION

According to the invention there is provided a conveyor roller casing having a plurality of co-extruded polymer layers, the conveyor roller casing including:

an inner layer formed from a first polymer material; and

an outer layer formed from a second polymer material;

wherein the outer layer of the roller casing is formed to have high wear-resistant properties, and wherein the conveyor roller casing includes a wear indicator for providing a visual indication of the wear of the roller casing.

Preferably, the inner layer of the roller casing is formed to have any one or combination of the characteristics of high flexural strength, high flexural modulus and high tensile strength.

Further features of the invention are contained in the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

An embodiment of the invention will now be described by way of example only with reference to the accompanying drawings in which:

Figure 1: shows a partially cutaway perspective view of a conveyor roller casing according to an embodiment of the invention;

Figure 2: shows a conveyor roller incorporating the conveyor roller casing illustrated in Figure 1;

Figure 3: shows a roller frame supporting a plurality of conveyor rollers of the type illustrated in Figure 2; and

Figure 4: is a flow chart outlining exemplary main steps in a production process for forming a conveyor roller casing according to the invention.

DETAILED DESCRIPTION OF AN EMBODIMENT OF THE INVENTION

Figure 1 of the drawings shows a conveyor roller casing 1 which includes an inner layer 2 and an outer layer 3 formed from polymer materials. The roller casing 1 may incorporate one or more additional intermediate layers (not shown) provided between the inner layer 2 and the outer layer 3.

With reference to Figure 2 of the drawings, the roller casing 1 is seen to form part of a conveyor roller 4, and is connected to other components of the roller 4 by a roller bearing housing 5. As the details of the other components of the roller 4 are well known to persons skilled in the art, it is not necessary to describe these components in further detail.

A plurality of rollers 4 are typically arranged together on a roller frame 6, as shown in Figure 3 of the drawings, and a plurality of such roller frames are typically spaced from one another to support a conveyor belt (not shown) of a conveyor system.

In this embodiment of the invention, the inner layer 2 and the outer layer 3 of the conveyor roller casing 1 are formed in a co-extrusion process.

The outer layer 3 is formed to have superior wear-resistant properties, and may be formed to also include other desirable properties such as UV stability, fire resistance and/or antistatic properties. The outer layer of the roller casing 1 is formed from a polymer material which may include any one or more of polyethylene, high density polyethylene (HDPE), ultra-high molecular weight polyethylene (UHMWPE), nylon or a similar hard wearing, abrasion resistant polymer. The outer layer 3 may also include an additive, such as glass fibres, to improve the wear resistance of this layer.

The inner layer 2 is formed to have different characteristics to the outer layer 3. Typically, these characteristics include any one or combination of high flexural strength, high flexural modulus, and/or high tensile strength. The inner layer 2 is also formed from a polymer material, which may include any one or more of polyethylene, high density polyethylene and nylon. Further, one or more additives may be used to improve the desired properties of the inner layer 2.

In one embodiment of the invention, the inner layer 2 is formed to have a different colour to the outer layer 3. This enables a user to easily detect when the roller casing 1 becomes worn and requires replacement. It will be appreciated that each layer of the roller casing 1 may be formed of any desired thickness, according to the application and desired wear resistance of the roller casing. As such, during the manufacturing process, the thickness may be pre-determined, and the manufacturing process set accordingly.

As stated above, one or more intermediate layers may be provided between the inner layer 2 and the outer layer 3. Such an intermediate layer may be formed from a polymer material of different colour to that of any of the other layers so as to provide an intermediate visual indication of the wear of the roller casing 1.

An outline of an exemplary co-extrusion process is illustrated in Figure 4. Prior to commencement of the production process, as will be appreciated by persons skilled in the art, the various dimensions of the desired roller casing 1 are determined, including the wall thickness of each of the layers 2 and 3. Once the appropriate preparations have been performed, the co-extrusion process can commence by extracting the appropriate polymer materials and additives from respective hoppers and feeding these materials to the extruder. As will be appreciated by person skilled in the art of co-extrusion, the mixing ratio, time, temperature and other characteristics may be varied depending upon the materials being used and the desired properties of the layers of the roller casing 1.

CLAIMS

1. A conveyor roller casing having a plurality of co-extruded polymer layers, the conveyor roller casing including:

   an inner layer formed from a first polymer material; and

   an outer layer formed from a second polymer material;

   wherein the outer layer of the roller casing is formed to have high wear-resistant properties, and wherein the conveyor roller casing includes a wear indicator for providing a visual indication of the wear of the roller casing.

2. A conveyor roller casing as claimed in claim 1, wherein the outer layer is formed from a polymer material including any one or combination of polyethylene, high density polyethylene (HDPE), ultra-high molecular weight polyethylene (UHMWPE) and nylon.

3. A conveyor roller casing as claimed in either claim 1 or claim 2, wherein the outer layer includes an additive in the form of glass fibres.

4. A conveyor roller casing as claimed in any one of the preceding claims, wherein the inner layer is formed to have any one or combination of the characteristics of high flexural strength, high flexural modulus and high tensile strength.

5. A conveyor roller casing as claimed in any one of the preceding claims, wherein the inner layer is formed from a polymer material including any one or combination of polyethylene, high density polyethylene (HDPE), ultra-high molecular weight polyethylene (UHMWPE) and nylon.

6. A conveyor roller casing as claimed in any one of the preceding claims, wherein the inner layer includes an additive in the form of glass fibres.

7. A conveyor roller casing as claimed in any one the preceding claims, wherein the outer layer is formed to be of a different colour to the inner layer to provide a visual indication of the wear of the roller casing.

8. A conveyor roller casing as claimed in any one of the preceding claims, further including an intermediate wear indication layer provided between the inner layer and the outer layer.

9. A conveyor roller casing as claimed in claim 8, wherein the intermediate wear indication layer is formed to be of a different colour to the inner layer and the outer layer.

10. A conveyor roller including the conveyor roller casing as claimed in any one of the preceding claims.

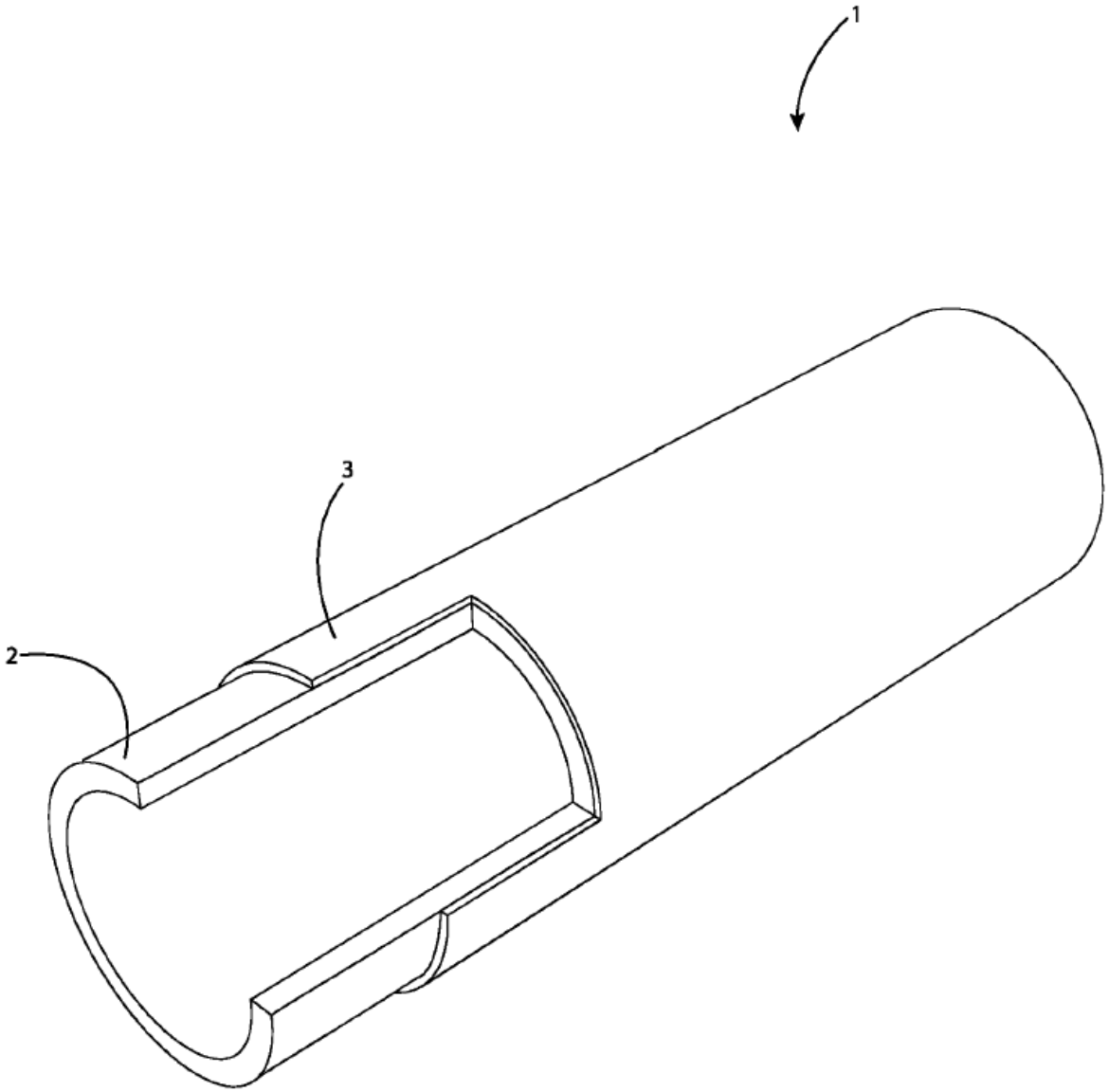


FIG 1

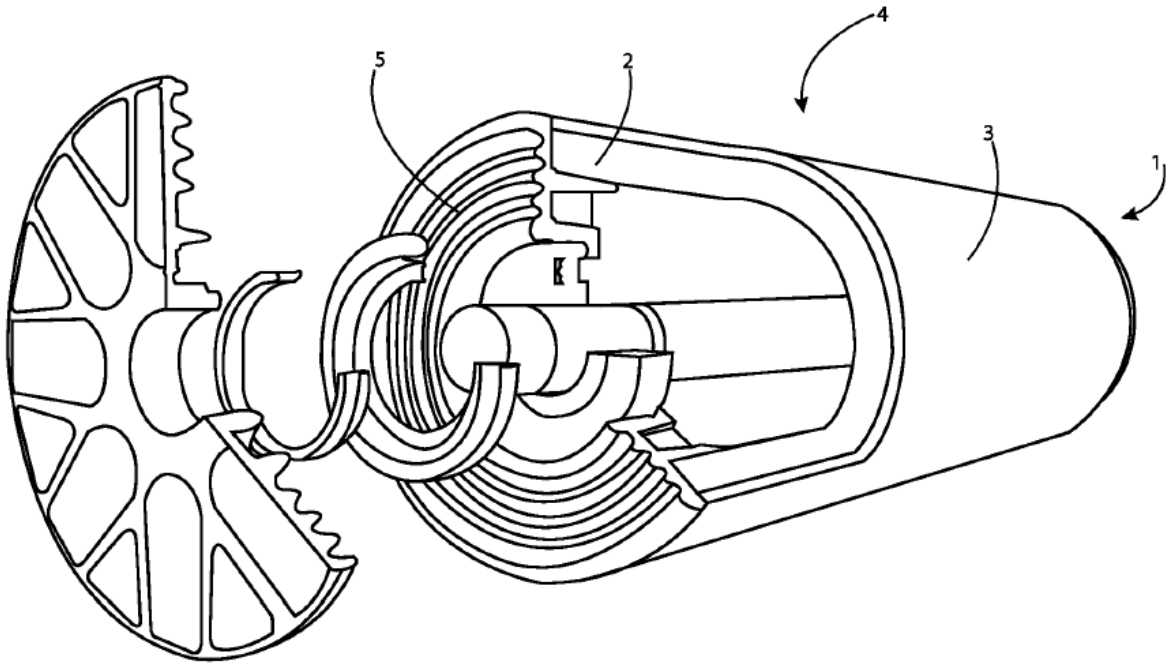


FIG 2

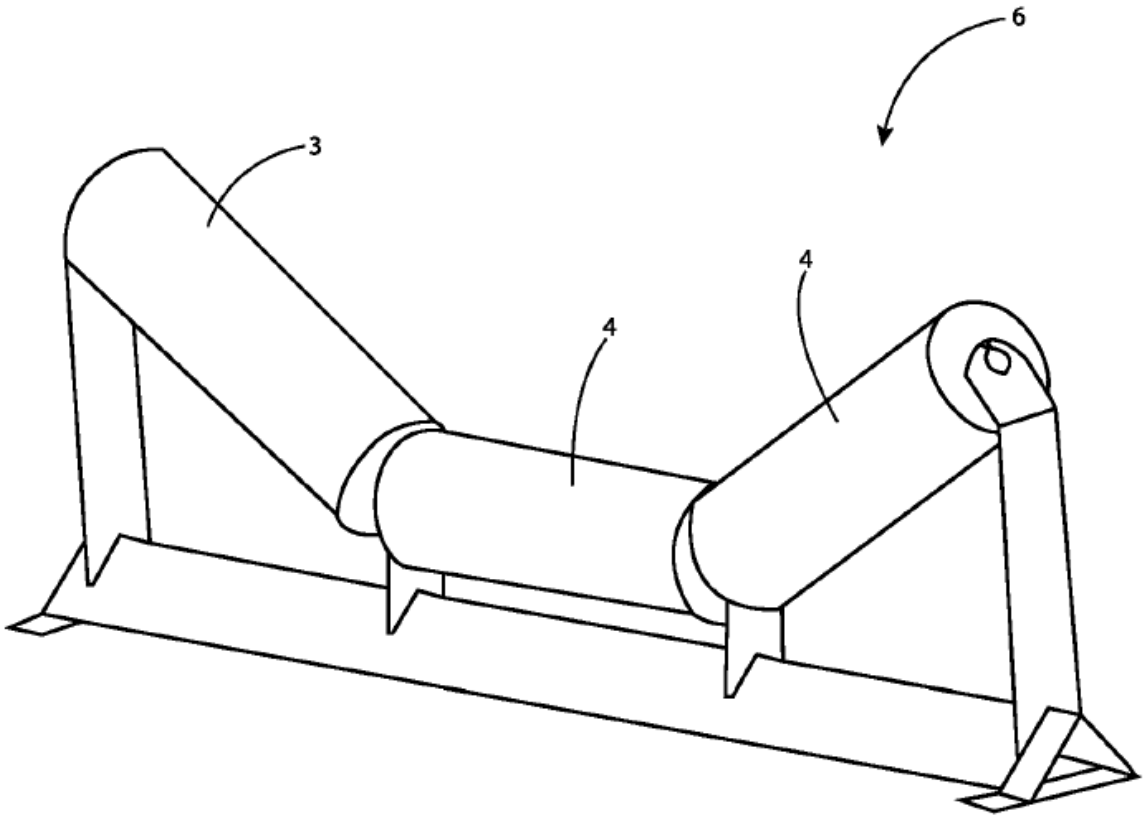


FIG 3

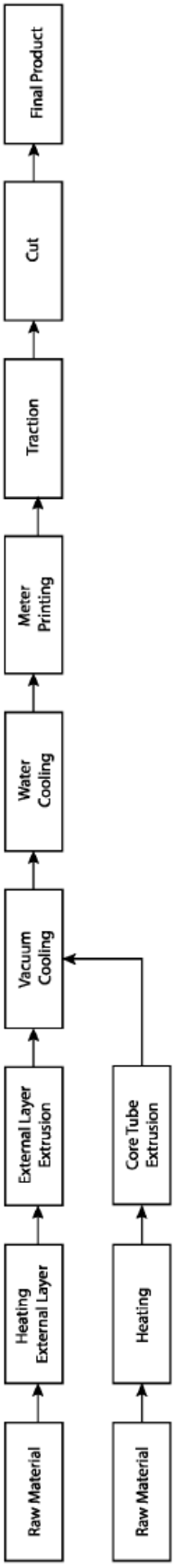

Final Product
Cut
Traction
Meter Printing
Water Cooling
Vacuum Cooling
External Layer Extrusion
Core Tube Extrusion
Heating External Layer
Heating
Raw Material
Raw Material

FIG 4

US 20050015986A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2005/0015986 A1**

Stebnicki et al. (43) **Pub. Date: Jan. 27, 2005**

(54) **METHOD OF MAKING A RETURN ROLLER**

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(21) Appl. No.: **10/736,070**

(22) Filed: **Dec. 15, 2003**

Related U.S. Application Data

(62) Division of application No. 10/322,025, filed on Dec. 17, 2002, now abandoned.

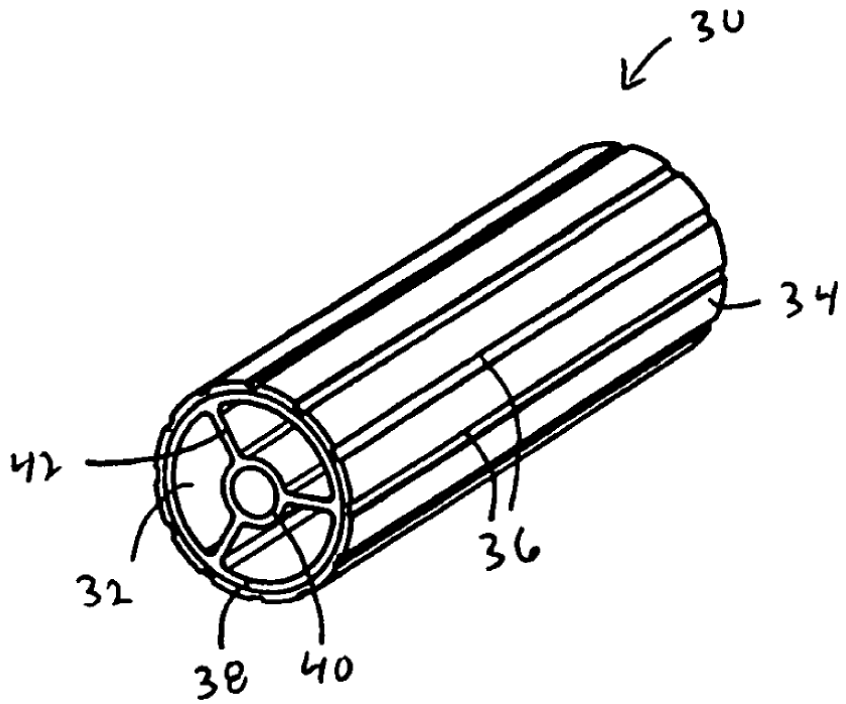
Publication Classification

(51) **Int. Cl.**[7] **B21B 1/40**; E01C 19/23

(52) **U.S. Cl.** **29/895.32**; 492/36

(57) **ABSTRACT**

A return roller for use in a conveyor system includes an extruded elongated cylindrical core defining a radially outwardly facing surface. A coating is coextruded with the portion of the core defining the radially outwardly facing surface, and in one embodiment, at least one discontinuity is formed in the coating to provide debris relief and indicate wear of the coating.



BACKGROUND OF THE INVENTION

[0001] The field of invention is conveyor systems, and more particularly a method of forming rollers used in endless chain or belt conveyor systems.

[0002] An endless conveyor chain or modular belt passes over a conveyor frame from a frame tail to a frame head to convey a product, and returns to the frame head beneath the frame in an endless loop. When the conveyor chain or belt returns beneath the conveyor frame, the chain or belt must be supported to prevent the chain or belt from striking the ground or some other object beneath the conveyor frame.

[0003] Unpowered return rollers are often used to support the return portion of the chain or belt. In many cases, the return rollers are special mechanical assemblies made by pressing bearings into the ends of a polyvinyl chloride (PVC) or steel pipe. These rollers often would not turn despite the bearings which resulted in the roller being unevenly worn down by the conveyor. In addition, a plain PVC pipe slid over a metal shaft without bearings is known.

[0004] A roller coated with a high friction material, such as rubber, which engages the conveyor chain return to force the roller to rotate is also known. This reduces the problem of uneven wear on the roller. However, these rollers are injection molded which limits the roller length. As a result, multiple rollers are required to accommodate wide chains or belts.

[0005] Another problem associated with the return rollers is debris and dust which can be caught between the return roller and belt or chain. The debris can become embedded in the roller, belt, or chain which can cause premature wear and failure. Therefore, a need exists for an improved return roller for use in belt or chain conveyor systems.

BRIEF SUMMARY OF THE INVENTION

[0006] The present invention provides a method of making a return roller for use in a conveyor system. The method includes extruding an elongated cylindrical core defining a radially outwardly facing surface, and co-extruding a coating onto at least a portion of the radially outwardly facing surface of the core. The coating is preferably co-extruded with at least one discontinuity formed in the coating to provide debris relief and indicate wear of the coating.

[0007] It is an object of the present invention to provide coated return rollers which can be formed in any length. This object is addressed by co-extruding at least the portion of the cylindrical core defining the radially outwardly facing surface with the coating.

[0008] The foregoing and other objectives and advantages of the invention will appear from the following description. In the description, reference is made to the accompanying drawings in which there is shown by way of illustration a preferred embodiment of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] FIG. 1 is a side view of a conveyor system incorporating the present invention;

[0010] FIG. 2 is a perspective view of one of the return rollers of FIG. 1;

[0011] FIG. 3 is a side view of the return roller of FIG. 2; and

[0012] FIG. 4 is a cross sectional view along line 4-4 in FIG. 3.

DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT

[0013] As shown in FIG. 1, a conveyor drive system **10** includes an endless conveyor belt **12** driven by a drive sprocket **14** that is rotatably coupled to a drive motor **16** by a drive belt **18**. The conveyor belt **12** travels over an upper support **20** between an idler sprocket **22** and the drive sprocket **14**, and returns beneath the upper support **20** as it travels between the drive sprocket **14** and the idler sprocket **22**. Return rollers **30** support the return section **24** of the belt **12** beneath the upper support **20**. Although two return rollers **30** are shown, one or more return rollers can be provided without departing from the scope of the invention. The term belt used herein shall be construed to include chains.

[0014] Referring to FIGS. 2 to 4, the return roller **30** includes an extruded roller core **32** on which a coating **34** is co-extruded. Advantageously, by co-extruding the coating over the cylindrical core, the roller can be formed having any length desired or formed having a standard length which can be cut to the desired length. In the preferred embodiment described below, the coating **34** includes at least one discontinuity **36** which can provide debris relief or indicate wear that requires roller replacement.

[0015] The roller core **32** shown in FIGS. 2 to 4 is formed from a rigid material with high flexural strength, such as glass-fiber reinforced polypropylene, or other thermoplastic material including PVC, and includes an outer cylindrical shell **38** joined to an inner cylindrical shell **40** by spokes **42** extending radially between the outer shell **38** and the inner shell **40**. The outer shell **38** defines a substantially continuous radially outwardly facing surface **44**. Although three spokes **42** is preferred to provide sufficient support for the outer cylindrical shell **38** with a minimum use of material, any number of spokes can be provided without departing from the scope of the invention.

[0016] The coating **34** is co-extruded onto the radially outwardly facing surface **44** of the outer shell **38**. Preferably, the coating **34** is a thermoplastic rubber or urethane that has a high coefficient of friction compared to the core **32**, such that the interaction between the return section **24** and the roller **30** will cause the roller to spin and prevent uneven wear. In certain applications, however, it may be advantageous to use a hard, wear resistant material for the coating **34**, such as PVC, polyamide, acetal (POM), or polybutylene terephthalate (PBT) in abrasive environments.

[0017] Preferably, the coating **34** chemically bonds with the roller core **32** to fix the coating **34** relative to the core **32**. Although chemically bonding the coating **34** to the roller core **32** is preferred, the coating **34** can be fixed to the roller core **32** using a shrink fit, a mechanical bond, and other methods known in the art without departing from the scope of the invention.

[0018] A plurality of axially extending, radially spaced discontinuities **36** are formed in the coating **34** for debris relief. These discontinuities **36** provide a space for debris disposed between the roller **30** and the conveyor belt **12** such that the debris is not pressed into the conveyor belt **12** or the roller **30** and can fall harmlessly to the ground as the roller **30** rotates. Advantageously, the discontinuities **36** can also function as wear indicators to provide maintenance personal with

notice that the roller **30** needs replacement. Although a plurality of discontinuities **36** is preferred, one or more discontinuities **36** can be provided without departing from the scope of the invention. In the illustrated embodiment, the discontinuities **36** do not extend the entire depth of the coating **34**. However, the discontinuities **36** can be formed by applying the coating in axially extending strips on the radially outwardly facing surface **44** of the cylindrical core **32** exposing portions of the cylindrical core **32**.

[0019] Each roller **30** rotates on a shaft **46** (see FIG. 1) extending through the inner cylindrical shell **40**. The shaft **46** can be fixed at both ends, such that it does not rotate. In applications where no relative movement between the shaft **46** and roller **30** is desired, the shaft **46** can be rotatably mounted using bearings (not shown), such that the roller **30** can rotate with the shaft **46**. In this application, the roller **30** can be fixed to the rotating shaft using a key, square shaft in a square bore, or by bonding the roller to the shaft using adhesives, fasteners, and the like.

[0020] While there has been shown and described what is at present considered the preferred embodiment of the invention, it will be obvious to those skilled in the art that various changes and modifications can be made therein without departing from the scope of the invention defined by the appended claims.

CLAIMS

1. A method of making a return roller for use in a conveyor system, the method comprising:

extruding an elongate roller core defining a radially outwardly facing surface, and including an axial opening for receiving a shaft; and

coextruding a coating over said radially outwardly facing surface for engagement with a conveyor belt.

2. The method as in claim 1, including forming at least one axially extending discontinuity in the coating to provide debris relief and indicate wear of the coating when the return roller is used in the conveyor system.

3. The method as in claim 2, in which the at least one discontinuity does not expose the radially outwardly facing surface of the core.

4. The method as in claim 2, in which the at least one discontinuity exposes at least a portion of the core.

5. The method as in claim 1, in which extruding the elongate roller core includes forming an outer cylindrical shell to define said radially outwardly facing surface.

6. The method as in claim 5, in which extruding said elongate roller core includes forming an inner cylindrical shell joined to the outer cylindrical shell by at least one radially extending spoke.

7. The method as in claim 1, in which at least one shaft is inserted into the core.

8. The method as in claim 1, in which the core is extruded onto a shaft.

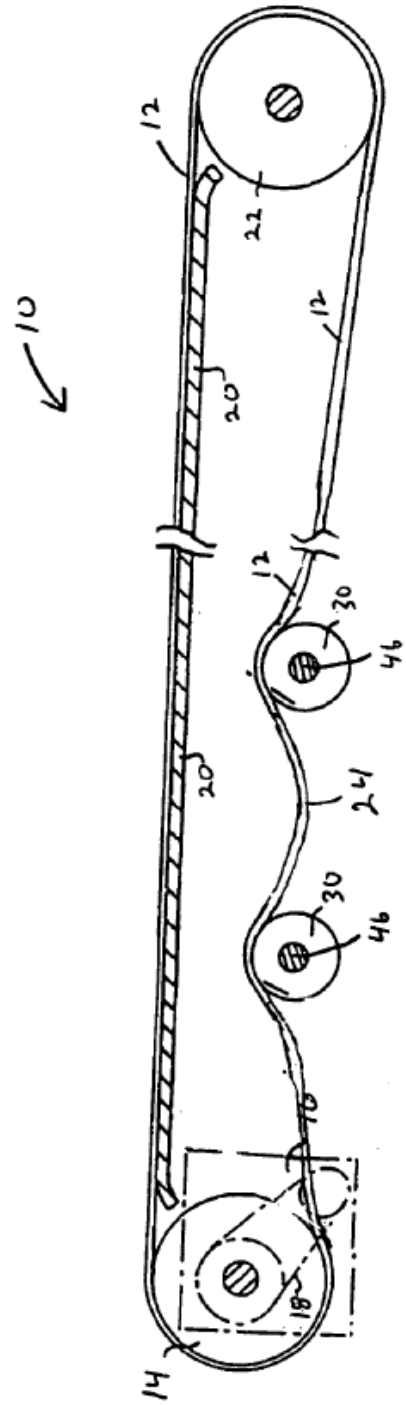


Fig. 1

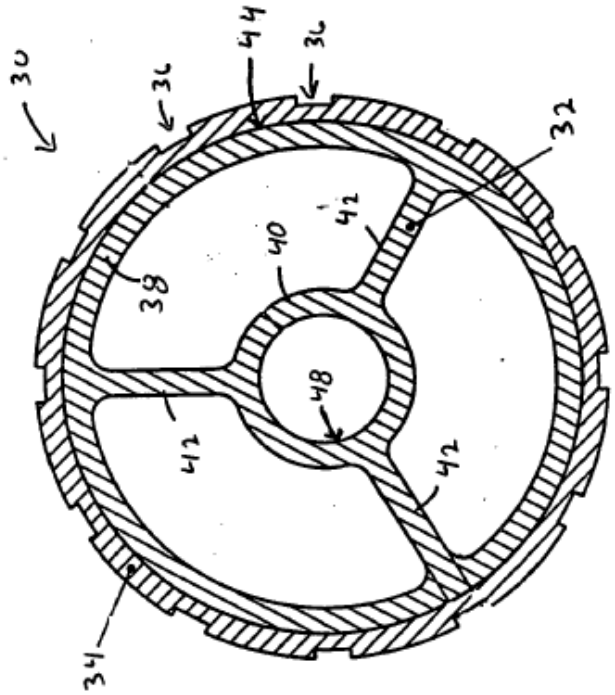


Fig. 4

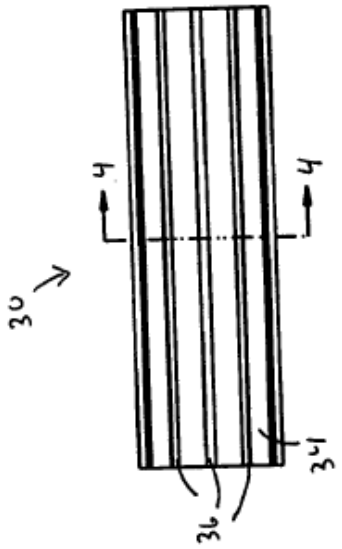


Fig. 3

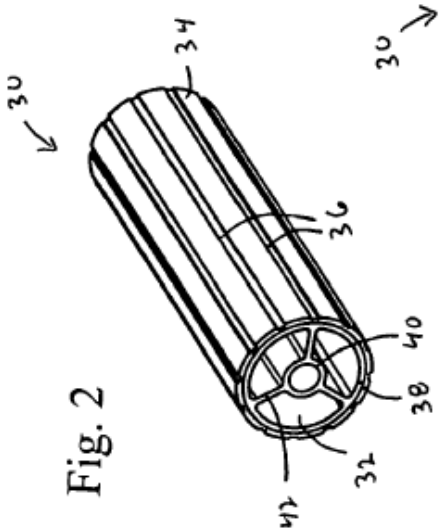


Fig. 2

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
29 January 2015 (29.01.2015)

WIPO | PCT

(10) International Publication Number
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23 July 2014 (23.07.2014)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
2013902725 23 July 2013 (23.07.2013) AU

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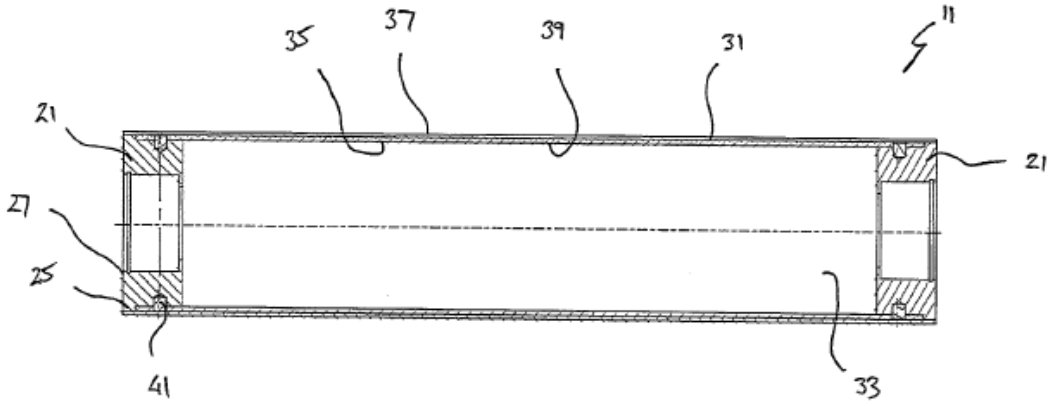

FIGURE 1

(57) Abstract: The present invention provides a roller (11) comprising a shaft (13) and an end cap assembly rotatably secured adjacent each end of the shaft. The roller also comprises a roller casing (31) extending between the end cap assemblies wherein the roller casing is a composite material comprising at least an inner layer (35) and an outer layer (37) wherein the outer layer has wear resistant properties.

ROLLER

TECHNICAL FIELD

[0001] The present invention relates to a roller for use in conveyors. In particularly the invention relates to roller construction.

BACKGROUND ART

[0002] Conveyors are used in many industries to convey material from one location to another for various purposes. By way of example, in the mining industry conveyors are used to carry ore or other material around a site, from site to site, as well as to loading bays and on to ships, trains, trucks and/or other suitable transportation.

[0003] Most conveyors employ a conveyor belt that moves over a series of supporting, rotatable rollers (or idlers). The conveyor belt moves over the rollers, with the underside of the conveyor belt contacting the rollers, while the upper side of the conveyor belt carries the material being conveyed.

[0004] The rollers are generally supported beneath the conveyor belt in roller frames which are typically mounted beneath the conveyor belt, with each roller frame typically supporting multiple rollers. These rollers support the load of the material conveyed on the conveyor belt and are often under constant heavy load. For example, the belts in the iron ore mining industries carry very large loads, up to 10,000 tonnes per hour, 24 hours per day.

[0005] Rollers are generally constructed to have a roller casing mounted onto a shaft. The roller casing is rotatably secured to the shaft by two end caps located adjacent each end of the shaft. These end caps support bearings which allow rotation of the roller casing relative to the shaft.

[0006] A downside of current rollers is that they are generally designed to be an integrated unit, making the replacement of any components that fail very difficult without damaging other components. As a result, rollers are typically disposed of once they have failed. Thus, once a component of the roller is damaged or worn out, inevitably the whole roller must be replaced.

[0007] Also, current steel rollers tend to be relatively heavy, and this makes handling of such rollers difficult.

[0008] The present invention attempts to address these problems by providing a roller that is of lightweight construction, and that includes components that are relatively easy to replace when worn.

SUMMARY OF INVENTION

[0009] The present invention provides a roller comprising:

a shaft;

an end cap assembly rotatably secured adjacent each end of the shaft; and

a roller casing extending between the end cap assemblies, wherein the roller casing is a composite material comprising at least an inner layer and an outer layer, wherein the outer layer has wear-resistant properties.

[0010] In contrast to the prior art, the composite construction of the roller casing can use different materials which, once combined, provide the requisite wear and strength characteristics, while being significantly lighter than if the roller casing was made from steel.

[0011] The shaft may be of hollow construction. The shaft may be made from carbon fibre and/or carbon steel. This further reduces the weight of the roller while still providing the requisite strength. Each end of the shaft may receive an end plug configured to engage with a roller frame of the conveyor system.

[0012] The end caps may be made from carbon fibre or a lightweight alloy, and each end cap may incorporate a plurality of blind holes therein to further reduce the weight of the end cap.

[0013] Preferably the roller casing is releasably secured to each end cap assembly.

[0014] In one aspect of the invention the roller casing is secured to each end cap assembly by at least one removable pin. The at least one pin may be in the form of a carbon fibre dowel.

[0015] Preferably the roller may be disassembled to allow the bearings and other worn or damaged components to be replaced and the roller re-assembled for continued use.

[0016] The inner layer of the roller casing may comprise a plurality of layers.

[0017] The outer layer of the roller casing may also comprise a plurality of layers.

[0018] One or more of the layers may be of different colour to provide a visual wear indicator, allowing an operator to visually identify the degree of wear of the roller.

[0019] In one aspect of the invention the roller casing is a carbon fibre composite construction. The casing's inner layer may be carbon fibre, and the outer layer may be made from an abrasive resilient material. The thickness of the inner layer may be in the order of 4mm. The thickness of the outer layer may be in the order of 3mm.

[0020] The inner layer may be formed by combining carbon fibre and resin at high temperature to form a carbon fibre tube. The tube may be manufactured such that it comprises multiple layers.

[0021] The outer layer may be formed by applying an abrasion resistant layer to the inner layer. The outer layer may be a high molecular weight polyethylene sleeve, a chopped strand mat (CSM) laminate, or may be formed from polyurethane. The outer layer may be sprayed on or brushed on.

[0022] In another aspect of the invention the roller casing is an aluminium, steel composite construction. The casing's inner layer may be made from aluminium, and the outer layer made from carbon steel. The carbon steel may be sprayed on to the inner layer.

[0023] The roller may have a cavity defined between the end cap assemblies, the shaft and the roller casing. The cavity may be filled with a material which does not expand or contract when exposed to changes in temperature. Preferably the material is polyurethane. The material may be injected into the cavity such that there is substantially no air in the roller cavity. As the cavity is full of the injected material no dirt can pass into the cavity and into the bearings. The material also reduces the noise generated by the roller.

[0024] In another aspect of the invention the roller casing is of a polyethylene composite construction. The casing's inner layer may be made from polyethylene having light weight characteristics, and the outer layer may be made from polyethylene having wear resistant characteristics. The inner layer may extend from the outer layer to a shaft cavity which receives the shaft.

[0025] In contrast to the prior art, the construction of the roller of the present invention is significantly lighter and quieter while still meeting the required load and wear conditions.

[0026] The present invention further provides a conveyor having one or more of the rollers as hereinbefore described fitted thereto.

BRIEF DESCRIPTION OF THE DRAWINGS

[0027] Further features of the present invention are more fully described in the following description with reference to the accompanying drawings in which:

Figure 1 is a cross-sectional view of a roller according to an embodiment of the invention without a shaft and bearings depicted;

Figure 2 is a cross-sectional view of the roller of Figure 1 without an outer layer depicted;

Figure 3 is a front view of an end cap of the roller shown in Figure 1;

Figure 4 is a cross-sectional side view of the end cap shown in Figure 3;

Figure 5 is a side view of a shaft for use with the roller shown in Figure 1; and

Figure 6 is a cross-sectional view of the shaft shown in Figure 5 taken along line A-A.

DESCRIPTION OF EMBODIMENTS

[0028] Referring to Figures 1 to 6 of the drawings, a roller 11 includes a shaft 13 in the form of a hollow pipe 14, and an end plug 15 inserted into each end of the hollow pipe 14. Each end plug 15 is adapted to be received in a roller cradle of a roller frame (not shown).

[0029] The roller 11 also includes an end cap assembly which is rotatably secured adjacent each end plug 15 of the shaft 13. Each end cap assembly comprise an end cap 21, a bearing (not shown), and a series of seals (also not shown). To reduce weight, each end cap 21 defines a series of blind holes 23. As shown in Figure 4, the end caps 21 are each provided with a shoulder 25 which extends radially outward adjacent an outer face 27 of the end cap 21. Each end cap 21 also has two apertures 29 (see Figure 3) extending radially inward for reasons which will be described below.

[0030] The two end cap assemblies are fixed relative to each other by a roller casing 31 such that they rotate simultaneously. The roller casing 31 extends between the end cap assemblies and is held in position relative to the end caps 21.

[0031] The roller casing 31 comprises an inner layer 35 and an outer layer 37 such that the roller casing 31 is a composite construction. In the illustrated embodiment, the inner layer 35 is formed from high strength carbon fibre. By roll wrapping, or filament winding, the carbon fibre is mixed with resin to form a tube 39 of carbon fibre having unidirectional piles. The thickness of the tube 39 is in the order of approximately 4mm. Once the tube 39 is formed to the required length the end caps 21 may be positioned in either end. The end caps 21 are inserted into respective ends of the tube 39 until the edge of the tube 39 abuts the shoulder 25 of each end cap 21. Pins in the form of dowels 41 are then inserted through the tube 39 and into the apertures 29 of the end caps to secure the tube 39 to each end cap.

[0032] The outer layer 37 may then be formed over the inner layer 35. The outer layer 37 encapsulates the inner layer 35 and extends over the shoulder 25 to terminate substantially adjacent the outer face 27 of each end cap 21, as best shown in Figure 1. The outer layer 37 is formed by spraying polyurethane directly onto the inner layer 35 to a thickness of 3mm. The polyurethane may also be cast thereon, or otherwise formed as would be known to the person skilled in the art.

[0033] In an alternative construction the outer layer 37 may be in the form of a polyethylene sleeve.

[0034] In a further alternative construction the outer layer may be in the form of a SiC/CSM laminate. In this case, a sleeve is manufactured from a SiC/CSM filled resin. During the manufacture of the sleeve it is important that there are minimal voids, that any butt joints do not coincide and that there are no gaps between the edges of the material. The sleeve is allowed to cure before placing the completed sleeve on a machine capable of grinding the external surface parallel to the centreline of the tube. Minimal material shall be removed, so that the remaining wall thickness shall be a minimum of 3mm over the entire sleeve. A final layer of resin is applied before it is placed over the inner layer 35.

[0035] In still a further construction according to the invention, the roller casing may be of a polyethylene composite construction. In this embodiment, the casing's inner layer may be made from polyethylene having light-weight characteristics, and the outer layer may be made from ultra-high molecular weight polyethylene which has wear-resistant characteristics. Also, the outer layer may be of a different colour to the inner layer. This colour difference serves to provide a visual indication of wear, alerting an operator to the need for roller replacement.

[0036] The roller 11 also incorporates a cavity 33 (see Figure 1) which is defined between the end cap assemblies, the shaft 13 and the roller casing 31. The cavity 33 may be injected with a temperature compensating means (not shown), in the form of polyurethane. The polyurethane is injected into the cavity 33 such that the air is expelled from the cavity and there are no pockets of air left therein.

[0037] Once the polyurethane has been injected and set, the bearings are fitted to complete the assembly of the roller.

[0038] To further enhance the roller of the present invention the end caps may be made from a lightweight alloy capable of withstanding significant loading. With such end caps the roller may be easily refurbished when the roller bearings/seals are damaged, without affecting the fine tolerance or the balance of the roller.

[0039] The configuration of the roller provides a lightweight alternative to present day rollers without compromising strength or wear characteristics. This itself has cost benefits to the conveyor operator but also allows the maintenance technicians to complete any roller maintenance/replacement in a safer manner.

[0040] As may be noted by the construction of the roller 11, any damaged or worn seal, bearing or end cap may be replaced or repaired. It is therefore not necessary to dispose of the whole roller when a component fails.

[0041] While the above discussion considers conveyors in the mining environment the present invention has application to any roller used in any conveying or similar system.

CLAIMS

1. A roller comprising:
a shaft;
an end cap assembly rotatably secured adjacent each end of the shaft; and
a roller casing extending between the end cap assemblies, wherein the roller casing is a composite material comprising at least an inner layer and an outer layer, wherein the outer layer has wear-resistant properties.

2. The roller according to claim 1, wherein the shaft is of hollow construction.

3. The roller according to either claim 1 or claim 2, wherein the shaft is made from carbon fibre and/or carbon steel.

4. The roller according to any preceding claim, wherein the end caps are made from carbon fibre or a lightweight alloy.

5. The roller according to any preceding claim, wherein each end cap incorporates at least one blind hole therein to reduce the weight of the end cap.

6. The roller according to any preceding claim, wherein the roller casing is releasably secured to each end cap assembly.

7. The roller according to any preceding claim, wherein the inner layer of the roller casing comprises a plurality of layers.

8. The roller according to any preceding claim, wherein the outer layer of the roller casing comprises a plurality of layers.

9. The roller according to any preceding claim, wherein one or more of the layers is of different colour to provide a visual wear indicator, allowing an operator to visually identify the degree of wear of the roller.

10. The roller according to any preceding claim, wherein the roller casing is a carbon fibre composite construction.

11. The roller according to claim 10, wherein the casing's inner layer is carbon fibre, and the outer layer is made from an abrasive resistant material.

12. The roller according to claim 10, wherein the inner layer is formed by combining carbon fibre and resin at high temperature to form a carbon fibre tube.

13. The roller according to any preceding claim, wherein the outer layer is formed by applying an abrasion resistant layer to the inner layer.

14. The roller according to any preceding claim, wherein the outer layer is a high molecular weight polyethylene sleeve, a chopped strand mat (CSM) laminate, or is formed from polyurethane.

15. The roller according to any preceding claim, wherein the outer layer is sprayed on or brushed on.

16. The roller according to any preceding claim, wherein the roller casing is an aluminium, steel composite construction.

17. The roller according to claim 16, wherein the casing's inner layer is made from aluminium, and the outer layer is made from carbon steel.

18. The roller according to any preceding claim, wherein the roller casing is of a polyethylene composite construction, with the inner layer being formed from polyethylene having light weight characteristics, and the outer layer being formed from polyethylene having wear resistant characteristics.

19. A conveyor including one or more of the rollers as claimed in any preceding claim.

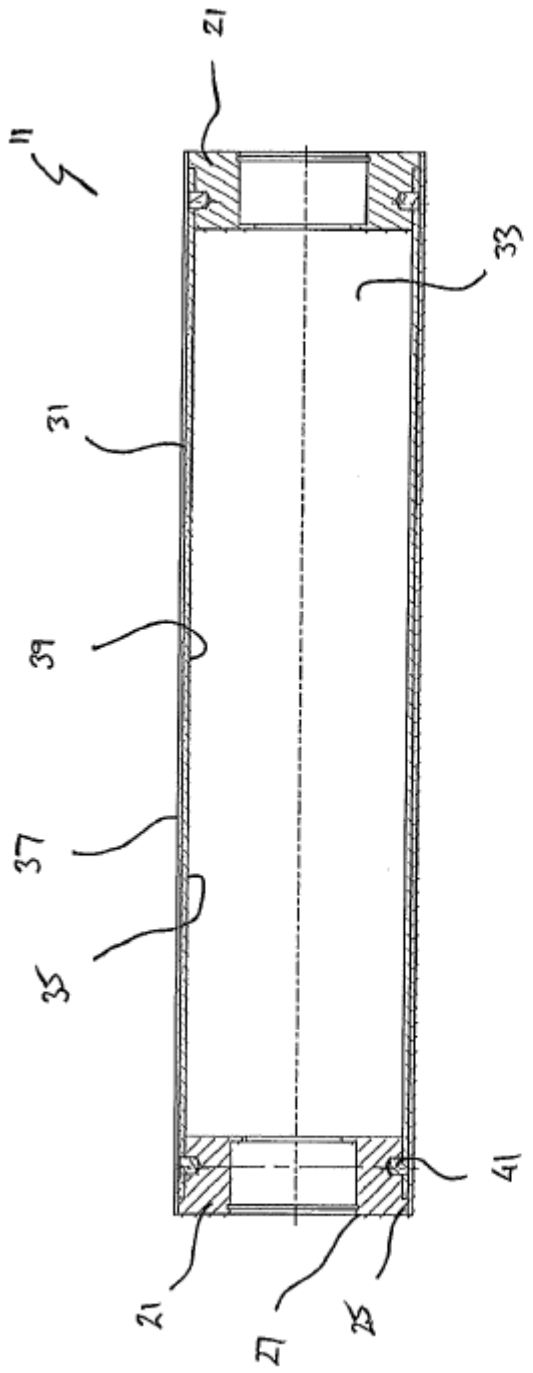

FIGURE 1

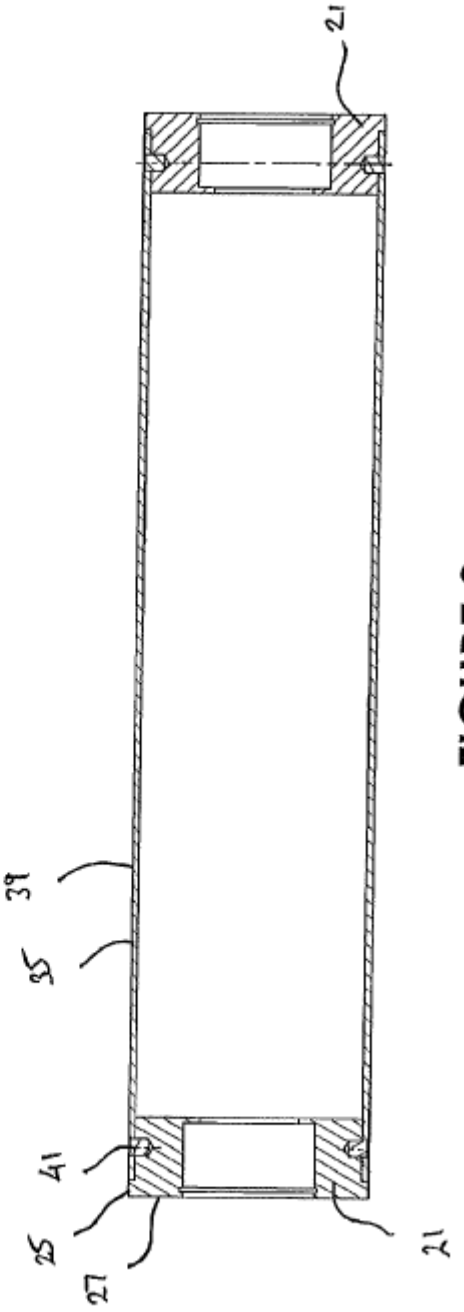

FIGURE 2

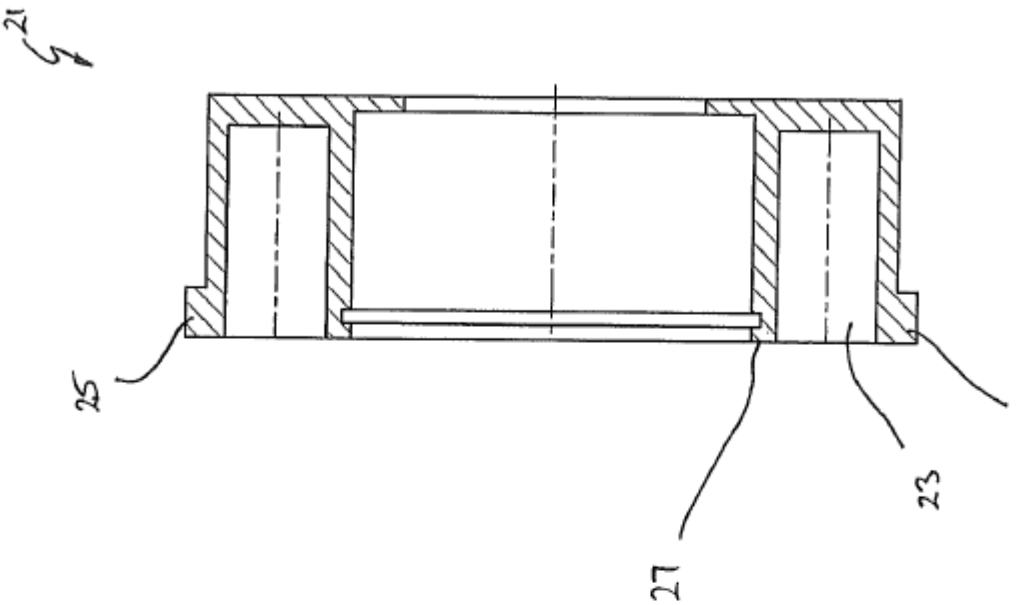

FIGURE 4

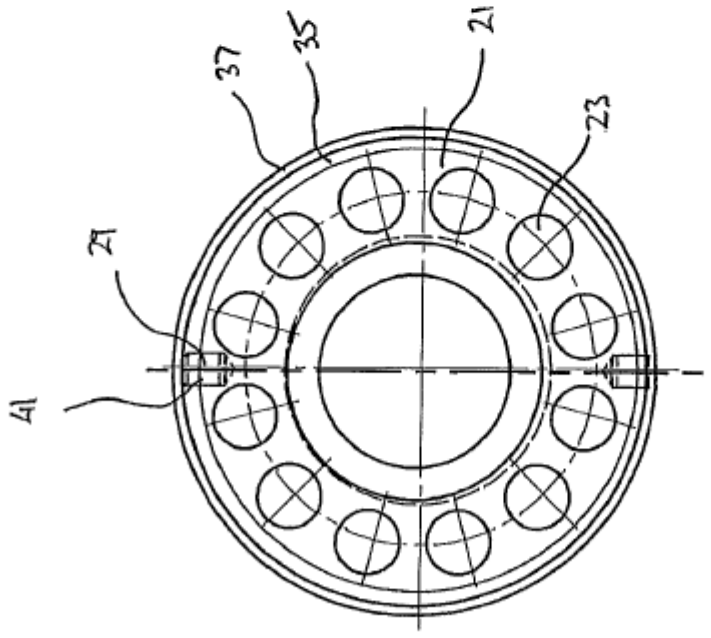

FIGURE 3

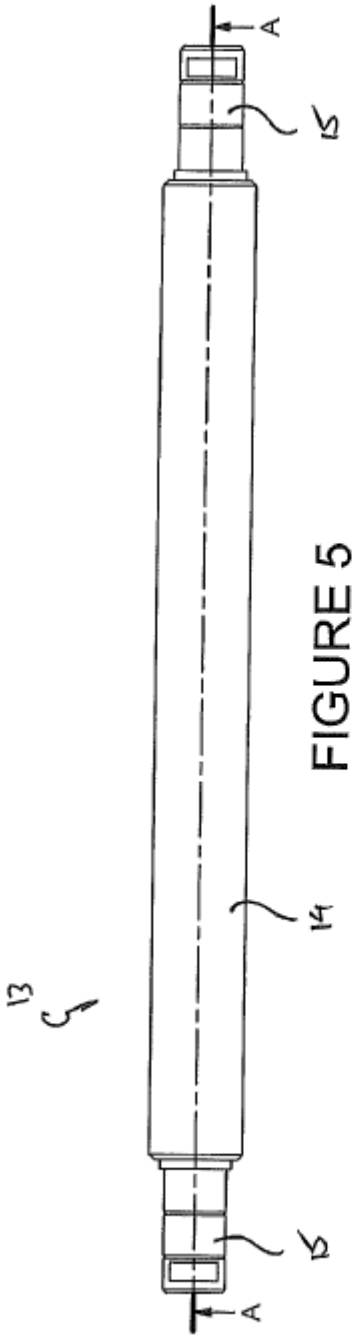

FIGURE 5

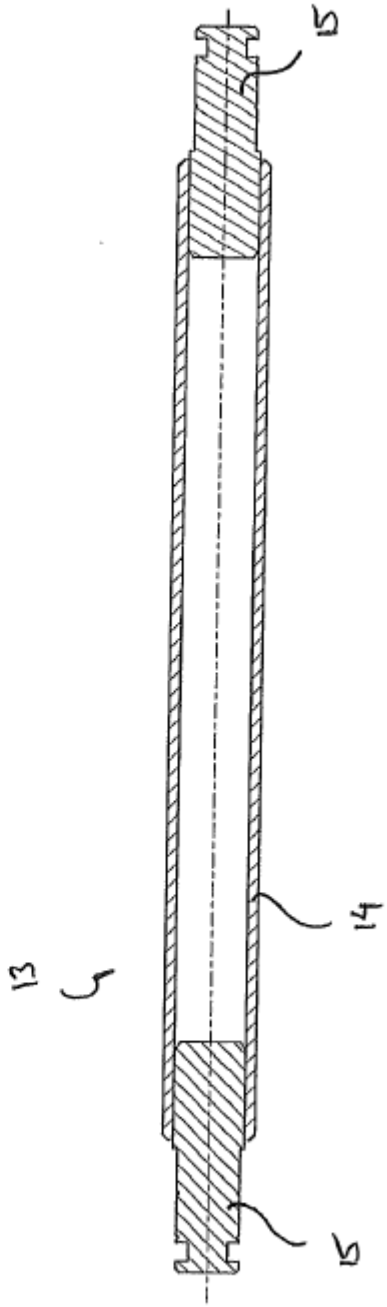

FIGURE 6