

MULTI-LOCKING PULLEY

Technical Field

- 5 This invention relates to a pulley and a method of manufacturing a pulley.

Background of the Invention

Principles of the present invention will be discussed in relation to a pulley and a
10 method of manufacturing a pulley, such as that used in industrial manufacturing,
construction, agriculture, oil and gas, automotive and general industries. Some
examples are shown in Figures 11 and 12.

It should be appreciated however that the principles of the present invention can apply to
15 manufacture of a wide range of Multi-locking Pulleys, providing combinations of
various pulley sizes to various sizes of sleeve and various numbers of sleeves. Some
examples are shown in Figure 6.

Present methods of manufacturing a pulley include sand casting, die cast, investments
20 cast iron or metal stamping. Of these, sand casting of iron is the prevalent method of
manufacturing pulleys.

These processes are complicated, expensive, labour intensive and place limitations on
the design of the pulley.

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Sand casting of an iron pulley involves the placement of a particular pulley pattern
(generally an aluminium mould) into casting sand, which is packed around the
aluminium pulley mould. The mould, and hence the pulley eventually manufactured,
must be tapered and ready for removal of the mould from the packed sand. It should
30 be noted that the sand might include inserts for the pulleys.

Once the mould is removed, hot iron is then poured into the sand mould. Once the

metal has cooled sufficiently, the sand mould is broken and the rough pulley cast removed.

Next, the pulley has to be machined to the desired pulley sleeve size.

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Next, the pulley is sent to apply putty for filling up holes caused by bubbles during casting. The putty also requires sanding down manually by sandpaper before sending to the next process (painting).

- 10 The cast iron pulleys are also heavy because they are generally cast in full form with the core and pillar and sleeves all in one piece. Examples of this can be seen in Figure 13.

15 A typical cast iron pulley formed through a casting process is extremely heavy due to the limitation of the casting process requiring thicker walls all around the entire pulley.

The destruction of the mould insert every time a pulley is manufactured is expensive. Also expensive is the labour to provide the extra machining of the pulley piece by
20 piece.

Another problem is that manufacturers are slow to cast the pulley one by one in accordance to the desired model of the pulley required by a customer.

- 25 It would be desirable if there could be provided a method of pulley manufacture that overcomes these problems.

It is an object of the present invention to address the foregoing problems or at least to provide the public with a useful choice.

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Further features and advantages of the present invention will become apparent from the ensuing description, which is given by way of example only.

Summary of the Invention

5 According to one aspect of the present invention there is provided a method of manufacturing a multi-part pulley, including the steps of:

forming a plurality of components by extruding material and cutting the extruded material to a desired length; and

joining the plurality of components to form the multi-part pulley.

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Another aspect of the invention relates to a multi-part pulley manufactured according to the method described above.

15 The process of extrusion is one not normally thought of when looking at pulley manufacturing. This is because the design of the pulley is such that it would be difficult to apply the extrusion process. Existing designs do not have the substantially constant diameter of pulley and width of pulley for extrusion.

20 The inventor recognized that a new multi-locking pulley could be produced by an extrusion process with all its advantages.

It is envisaged that standard extrusion processes can be used with the present invention.

25 In preferred embodiments of the present invention the extrusion process is applied to the multi-locking pulley of:

1. different sizes of pulley,
- 30 2. different sizes of pulley disc as shown in Figure 7 item no. 1
3. different sizes (of the width) of pulley sleeve as shown in Figure 7 and 8 item

no. 2

4. different number of sleeves as shown in Figure 8 item no. 3
5. different sizes of pillar joint as shown in Figure 9 and
6. having a small number of common pulley cores as shown in Figure 10

An example of this multi-locking pulley system is shown in Figure 6.

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The kinds of multi-locking pulley that can be extruded are categorized into 2 categories. That is:

1. In a pulley of smaller sizes, a single pulley disc inter-locking one piece of pulley
15 core to make one complete assembled multi-locking pulley. An example of this is shown in Figure 4.
2. In a pulley of medium and large sizes, many components of the multi-locking pulley inter-locking each other with 1 piece of pulley core to make into 1
20 complete assembled multi-locking pulley. Examples of this are shown in Figures 1, 2 and 3.

It should be appreciated however that the present invention could apply to pulley having alternate sizes of the pulley and different number of sleeves and different sizes
25 of sleeve without having to change the pulley core or vice-versa.

This multi-locking pulley system also provides a wide selection of combinations one can achieve by selecting different pulley core for a different size of pulley and different number of sleeves as well as different sizes of sleeves. Examples of pulley
30 cores are shown in Figure 10.

A multiple sleeve pulley may be manufactured by extrusion process, or in alternative

embodiments of the whole range of pulley with multiple Disc and sleeves and sleeve sizes may be extruded at one time. An example of this multi sleeves are shown in Figures 7 and 8. Herewith showing the varieties of pulley disc and pulley sleeves respectively.

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One advantage of extruding the parts of the multi-locking pulley as opposed to the whole pulley casting is that the extrusion process is considerably easier. For example, the extrusion has less mass and is thus easier to handle in terms of sheer size and weight. Further, the less mass there is, the less restriction there has to be made on the
10 extrusion design to ensure that there is minimal distortion of the extrusion during the cooling process.

Even so with the extrusion process, considerably tighter dimensional tolerances can be obtained with extrusion than by casting.

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Obviously, if the multi-locking pulley is formed by several extruded components, then there must be provided a means by which they can be joined together to form a single pulley.

20 Attachment of the pulley parts may be through a conventional method such as Alan Key Screw, Bolts, Bracket and so forth. Such attachments are illustrated in Figures 1, 3 and 4 item no. 1.

However, in preferred embodiments the extrusion components are made so that they
25 have complimentary teethes and indentations, readily allowing the individual components to mesh or slot in to one another.

In particular, it is envisaged that a few choices of inter-locking connection can be employed. Examples of such are as that:

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1. Dove Trail arrangement as shown in Figure 5 item no. 1

2. Tongue and groove arrangement as shown in Figure 5 item no. 2

3. Star arrangement as shown in Figure 5 item no. 3

5 These arrangements have the advantages in that they can be readily incorporated into an extrusion and that the multi-locking pulley is secured over the whole depth of the multi-locking pulley.

10 The multi-locking pulley may be made of a variety of materials such as aluminium or suitable plastic. Composite and ceramic materials may also be used. However, such materials may also have inferior material strength, which is not good for the contemplated pulley applications.

15 It should be appreciated with the conventional cast iron pulley manufacturing method limits to each pulley, which are of different models with different sizes of pulley and different number of sleeves and different sizes of sleeves. Embodiments of the present invention ensure that there is uniformity of design and sizes and thus efficiency in the manufacturing and management process.

20 Another advantage of the present invention is that the core of the pulley (pulley core as shown in Figure 10) is extruded as one component. This provides an enormous advantage over conventional cast iron pulley because in the event that a component of the multi-locking pulley needs to be replaced, it is only necessary to replace the pulley disc or pulley sleeve or the pulley core, depending on which of the components is
25 worn out. This allows easy and almost immediate replacement unlike the conventional pulley which requires to replace the entire pulley. The conventional pulley may also need to be re-bored and this is normally done in another workshop, which is a slow process.

30 It should be appreciated that using aluminium will reduce the weight of the multi-locking pulley by approximately 50% as compared to a cast iron pulley.

It should be apparent that the present invention has a number of advantages over prior art. This advantage includes:

A Cheaper start up cost

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The extrusion manufacturing process requires only a relatively small number of dies (press mould) to extrude a large selection of multi-locking pulley. This results in a cheaper start up cost. In contrast, the conventional cast iron pulley requires one mould each for every model to be manufactured.

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B Faster start up time

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The extrusion manufacturing process can start up much faster with only a few dies for the large selection of multi-locking pulley. These dies can be machined by Computerized Machine Center. In contrast, with the conventional cast iron pulley, it will take a much longer time to start up a factory due to the fact that each mould has hand crafted out of wood then cast into aluminium moulds. This mould must be made for each and every model. To provide the full range of pulleys, they must take a long time to complete this task.

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C Mass manufacturing process

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The extrusion manufacturing process allows the multi-locking pulley to be produced in mass quantity. The concept of inter-locking the components allows the repetition of similar components to be used. This enables the extrusion of components in large quantities which is fast and cheap. In contrast, the conventional cast iron pulley manufacturing process is limited to production of the pulley one by one, which is relatively slow and expensive.

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D Uses less manpower

The extrusion manufacturing process can be done in mass production and hence may

require only a small amount of manpower. In contrast, the conventional cast iron pulleys are manufactured piece by piece and may require a large workforce.

E Less floor space

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The extrusion manufacturing process is made in mass production. And also due to the multi-locking system, the components are small and these all lead to a requirement of a much smaller factory floor space. This is different to the iron pulley manufacturing where by each and every pulley is cast in full form and occupies a large floor space to do sand casting.

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F Clean manufacturing process

The extrusion are manufactured without any toxic fumes, no smelting and all waste is recyclable, thus it is friendly to the environment. In contrast, the iron casting furnaces need coking coal of which there will be a world shortage. Burning of the coal produces "cupola emissions" which is an environmentally harmful gas.

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G Factory is easy to manage

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The extrusion manufacturing process provide mass production, good component tolerances and small manpower, which has made it all easier to manage on a factory level, compared to cast iron pulley where the manufacturing process is slow, pulleys are cast out in rough and a large workforce is required, which has contributed to a complex and difficult factory to manage.

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H Requires less inventory

The multi-locking pulley system has a great advantage of using common parts. Therefore the required inventory is smaller compared to the conventional cast iron pulley manufacturing, where the manufacturer requires a large selection of pulleys of different models to supply customer.

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I High turn over, low overhead

The extrusion manufacturing process provides mass production with minimal
5 manpower thus it provides a high turnover and low overhead. This ensures the
manufacturer to gain bigger profit. Unlike conventional cast iron pulley
manufacturer, which provides opposite, that is low turnover and high overhead and
making only small profit.

10 J No putty is required

The extrusion manufacturing process provides an excellent pulley finish and does not
require further touch up. In contrast, the conventional cast iron pulley requires further
touch up by applying putty into the holes left behind poor sand casting. Cast iron
15 pulleys also require sanding of the putty by sandpaper.

K No painting required

The extrusion manufacturing process produces excellent quality pulley components
20 which do not require further surface coating or painting. The conventional cast iron
pulley requires a coat of paint.

L Less waste of labour force

25 Less waste of labour force as separate mould and inserts are not destroyed every time
a pulley is produced.

N Fewer dies (mould)

30 A single extrusion tool die may be used to make the same parts of a variety of models
of multi-locking pulleys.

O Lighter material

The ability to use alternate material to cast iron means that the pulley can be much lighter in weight, which amongst other things gives better fuel and electric efficiency to the prime mover that drives the multi-locking pulley.

P A more balanced pulley

The extruded multi-locking pulley provides a more balanced pulley. Unlike the conventional cast iron pulley which are subject to potholes caused during the process of gravity casting.

A balanced multi-locking pulley will give better efficiency to the prime mover and equipment.

Q Saves Storage and Shipping Space

All the components of the multi-locking pulley are small and can be packed in a small box, which provides a great advantage to save storage and shipping space.

Unlike the conventional cast iron pulley, which is a fully formed pulley. It cannot be knocked down into components and thus takes a very large storage and shipping space.

25 **Description of the Drawings**

Further features of embodiments of the present invention will become apparent from the following description, which is given by way of example only and with reference to the accompanying drawing in which:

Figure 1 illustrates a preferred example of a multi-locking pulley constructed in accordance with the invention for larger range of pulleys good for the

normal pulley application.

Item no. 1 show the Alan Key Screw

Item no. 2 shows an example of pulley sleeve

Item no. 3 shows an example of a pillar joint

5 Item no. 4 shows an example of a pulley core

Figure 2 illustrates the complete assembly of a multi-locking pulley after all the components are held together.

10 Figure 3 illustrates a preferred example of a multi-locking pulley constructed in accordance with the invention, for medium size pulleys, good for normal pulley applications.

15 Picture A illustrates 3 pieces of pulley sleeve item no. 2 and 3 pieces of pillar joint item no. 3 which can be slotted together to make the shape of a pulley.

Picture B illustrates the pulley core item no. 4 which can be slotted into the center of the multi-locking pulley.

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Picture C illustrates 15 pieces of alan key screws item no. 1 used for tightening up all the components.

25 Picture D illustrates an example of a complete assembly of the multi-locking pulley.

Figure 4 illustrates a preferred example of multi-locking pulley constructed in accordance with the invention for smaller pulleys, good for the normal pulley applications.

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Pictures A and B illustrate 1 piece of pulley disc item no. 1. And 2 pieces of alan key screw item no. 2. And 1 piece of pulley core item

no. 3 are placed together to make the shape of a pulley.

Picture C illustrates an example of a complete assembly of a multi-locking pulley.

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Figure 5 illustrates some examples of the teeth arrangement that is used for inter-locking the components forming the multi-locking pulley system.

Picture no. 1 shows the dove tail teeth arrangement

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Picture no. 2 shows the tongue and groove arrangement

Picture no. 3 shows the star teeth arrangement

These teeth arrangements can be found in:

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- 1 pulley core as shown in Figure 10
- 2 pulley disc as shown in Figure 7
- 3 pulley sleeves as shown in Figure 8
- 4 pillar joints as shown in Figure 9

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Figure 6 illustrates that in the multi-locking pulley system, a common pulley core item no. 1 can be used to suit multi-locking pulleys of various pulley sizes, various pulley sleeve sizes and various pulley sleeves (shown here as item no. 2).

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Figure 7 illustrates some examples of the pulley disc item no. 1. In the multi-locking pulley system, pulley disc are made

- 1 in various pulley sizes as shown in item no. 1 and
- 2 in various sleeve sizes as shown in item no. 2 and
- 3 in various numbers of grooves as shown in item no. 3.

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To assemble into a complete multi-locking pulley, it is necessary only to use 1 piece of pulley disc.

Figure 8 illustrates some examples of the pulley sleeve used in various pulley sizes in the range of multi-locking pulley item no. 1. In the multi-locking pulley system, pulley sleeve are made:

- 5 1 in various pulley sizes and length as shown in item no. 4
- 2 in various sleeve sizes as shown in item no. 2 and
- 3 in various numbers of grooves as shown in item no. 3.

10 To assemble into a complete multi-locking pulley, it is necessary to use more than one piece of pulley sleeve.

Figure 9 illustrates some of the pillar joints which can be used in the multi-locking pulley system. In this system the pulley joints are made:

- 15 1 in various sizes as shown in item no. 1 and
- 2 also in various thicknesses to suit various numbers of grooves as shown in item no. 2.

20 To assemble into a complete multi-locking pulley, you are required to use more than one piece of pillar joint.

Figure 10 illustrates some examples of pulley cores used in the multi-locking pulley system. In this system the pulley cores are made of various sizes suitable for different pulley sizes as well as suitable for various sleeves sizes and various numbers of grooves.

25 To assemble into a complete multi-locking pulley, only one piece of pulley core is required.

30 Figure 11 shows some examples of the application of the multi-locking pulley.

Picture A illustrates a multi-locking pulley item no. 1 which can be

fitted to a prime mover item no. 2, which is an electrical motor.

Picture B illustrates a multi-locking pulley item no. 1 which can be fitted to a prime mover item no. 2, which is a diesel engine.

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Figure 12 shows some common examples of the application of the multi-locking pulley. They are:

	Picture	A	Generator
10	Picture	B	Mini Concrete Mixer
	Picture	C	Air Compressor
	Picture	D	Water Pump
	Picture	E	Chemical Sprayer
	Picture	F	Road Cutter
15	Picture	G	Cultivator
	Picture	H	Palm Oil screw Press

Figure 13 shows some examples of the conventional cast iron pulleys.

20 **Best Modes for carrying out the Inventions**

The multi-locking pulley has been designed to have a substantially constant cross section to readily allow the relevant components to be extruded.

25 The extrusion provides the flexibility to cut to any desired length. This process can be carried out by using a circular or hack saw.

It can be seen that the multi-locking pulley has minimal additional machining, mainly concerning the groove on the sleeve of the pulley sleeve. This process can be carried
30 out on a CNC lathe machine.

The multi-locking has been constructed to provide a number of inter-locking joints,

which enable the components to be slotted together with inter engaging teeth. These components are tightened (and held) by means of Alan key screws, for example, features of the present invention have been described by way of example only and it should be appreciated that modification and additions may be made thereto without
5 departing from the scope as defined in the appended claims.

CLAIMS:

1. A method of manufacturing a multi-part pulley, including the steps of:
forming a plurality of components by extruding material and cutting the
5 extruded material to a desired length; and
joining the plurality of components to form the multi-part pulley.
2. The method of claim 1, wherein the plurality of components include at least
two different components formed so as to have inter-locking portions by which the
10 different components can be joined to each other.
3. The method of claim 1 or claim 2, further including the step of:
before joining, machining at least one of the plurality of components so as to
form one or more pulley grooves in an outer circumferential portion thereof.
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4. The method of claim 3, wherein the machining further includes forming holes
in the components for receiving tightening means for tightly joining the components.
5. The method of any one of claims 1 to 4, further including the steps of treating
20 the multi-part pulley to provide a coloured anodized coating thereto.
6. The method of any one of claims 1 to 5, wherein one of the components is a
pulley core.
- 25 7. The method of claim 6, wherein one of the components is a pulley disc
adapted for interlocking engagement with the pulley core and having one or more
pulley grooves formed in an outer circumferential portion thereof.
8. The method of claim 6, wherein one or more of the components is a pillar joint
30 for joining to the pulley core.
9. The method of claim 8, wherein one or more of the components is a pulley

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sleeve for joining to the one or more pillar joint and having one or more pulley grooves formed in an outer circumferential portion thereof.

10. A multi-part pulley manufactured in accordance with the method of any one of
5 claims 1 to 9.