US007645089B2

(12) **United States Patent**
Hayes et al.

(10) **Patent No.:** **US 7,645,089 B2**
(45) **Date of Patent:** **Jan. 12, 2010**

(54) **HUB AND SECONDARY DRIVING ELEMENT SHAFT LOCKING SYSTEM**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 257 days.

(21) Appl. No.: **11/380,071**

(22) Filed: **Apr. 25, 2006**

(65) **Prior Publication Data**

US 2006/0240898 A1 Oct. 26, 2006

Related U.S. Application Data

(60) Provisional application No. 60/674,633, filed on Apr. 25, 2005, provisional application No. 60/678,153, filed on May 5, 2005.

(51) **Int. Cl.**
F16D 1/08 (2006.01)

(52) **U.S. Cl.** **403/359.5**; 464/182

(58) **Field of Classification Search** 403/1, 403/355, 359.5, 362; 464/182
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

166,799	A	*	8/1875	Murdock	403/362 X
2,355,899	A	*	8/1944	Beede	403/362 X
2,463,066	A	*	3/1949	Stuvel	403/362
2,795,398	A	*	6/1957	Ragland	403/355 X
2,859,939	A	*	11/1958	Petrell	403/359.5 X
3,463,520	A	*	8/1969	Turro	403/362
4,436,468	A	*	3/1984	Ozaki et al.	403/362 X
5,437,351	A	*	8/1995	Lindner	403/359.5 X
5,836,713	A	*	11/1998	Brassert et al.	403/359.5

* cited by examiner

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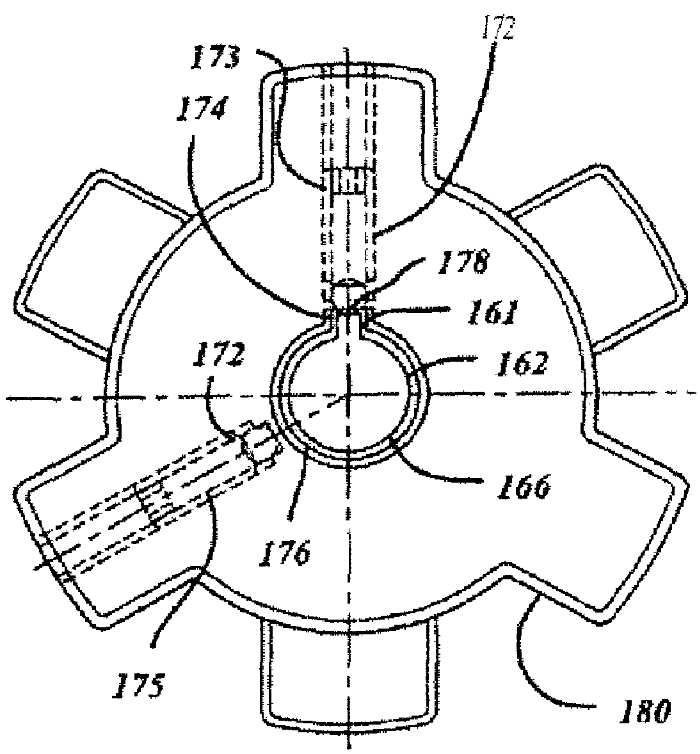
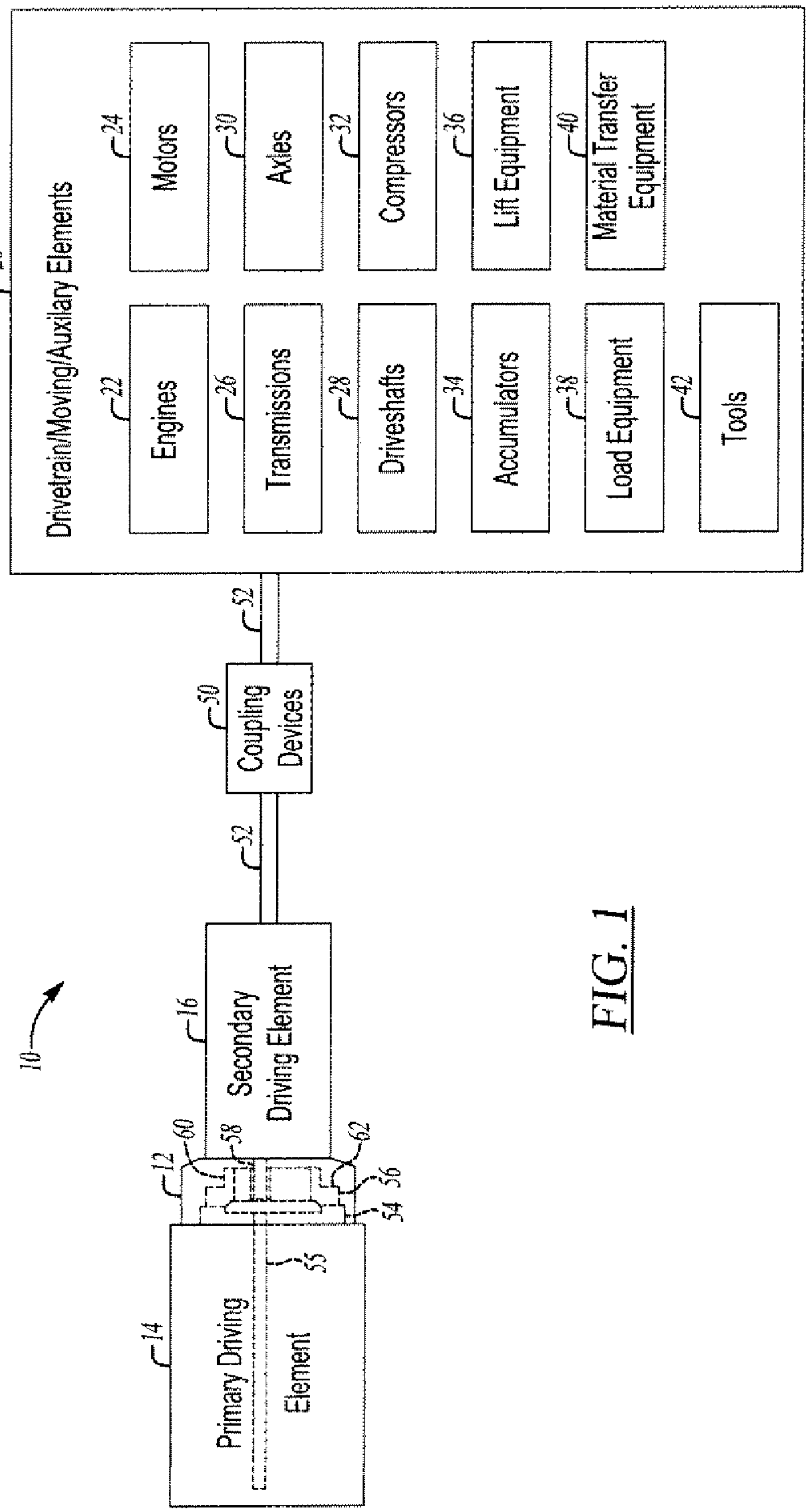
(57) **ABSTRACT**

A drive coupling hub (**60**) includes a body (**120**) and lugs (**126**) that extend radially from the body (**120**) and are engageable with a primemover (**54**) of a primary power source (**14**). The lugs (**126**) have a fastening lug (**80**) that includes a radially extending bore (**82**). A bearing (**88**) is set within the bore (**82**). A setscrew (**90**) extends within the bore (**82**) and applies pressure on the bearing (**88**) to engage the drive hub to a shaft (**58**) of a secondary power source (**16**).

29 Claims, 5 Drawing Sheets




Drivetrain/Moving/Auxilary Elements
Motors
Axles
Compressors
Lift Equipment
Material Transfer Equipment
Engines
Transmissions
Driveshafts
Accumulators
Load Equipment
Tools
Coupling Devices
Secondary Driving Element
Primary Driving Element
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14
16
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FIG. 1

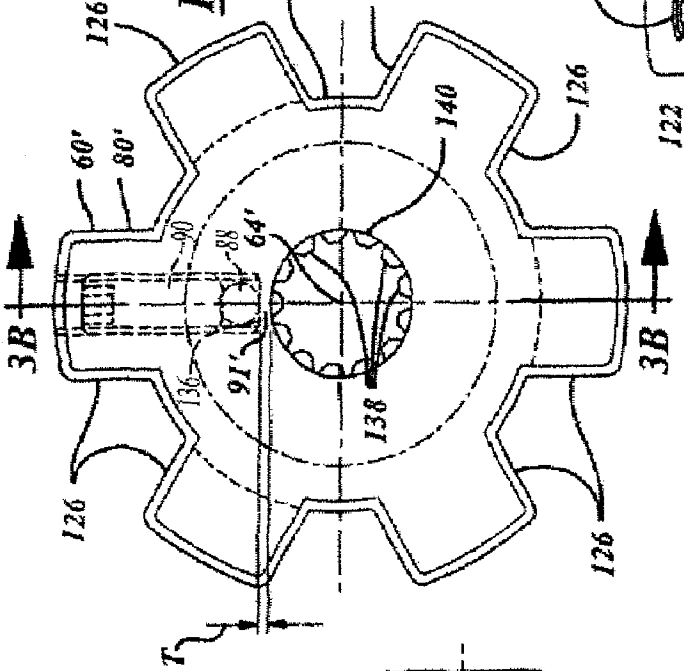


FIG. 3A

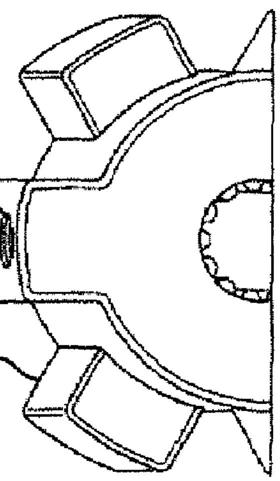


FIG. 3D

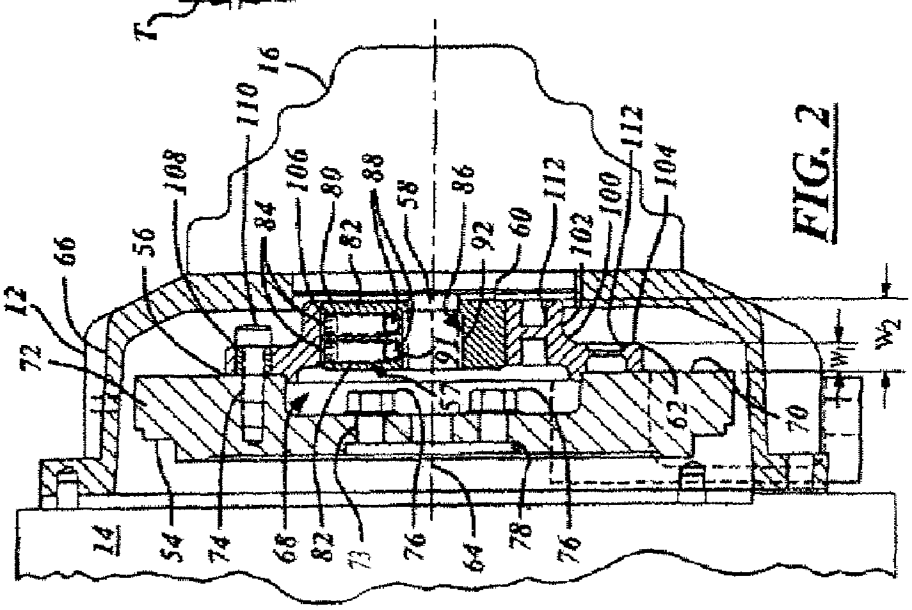


FIG. 2

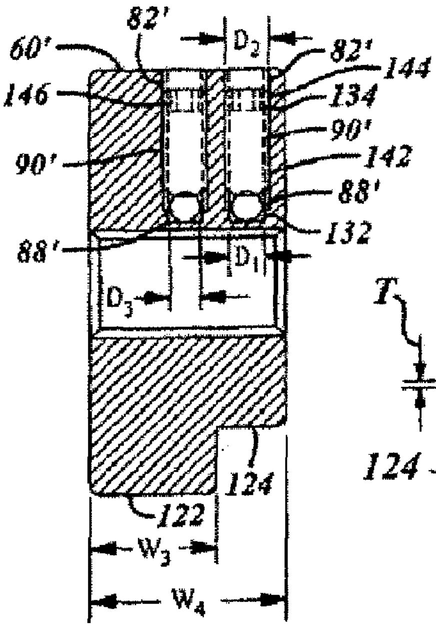


FIG. 3B

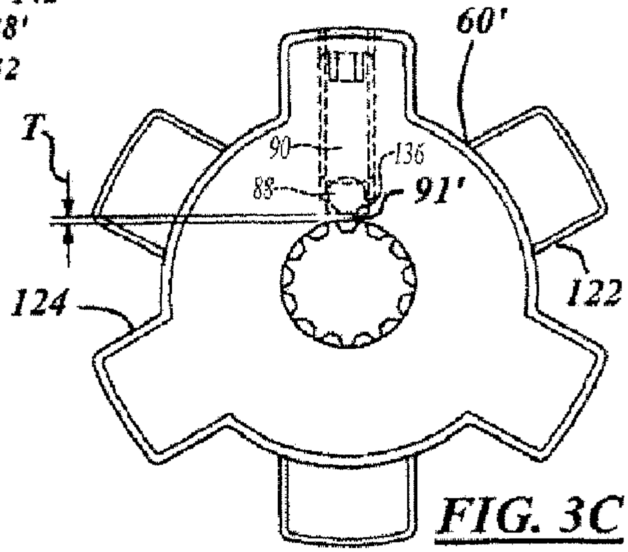


FIG. 3C

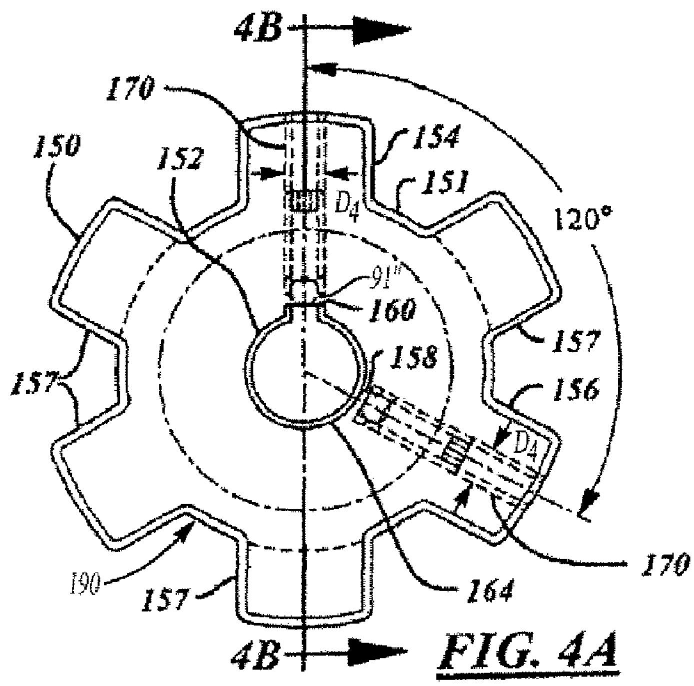


FIG. 4A

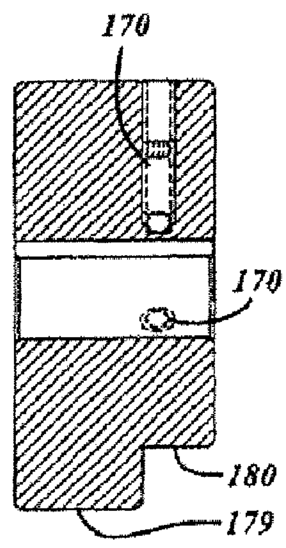
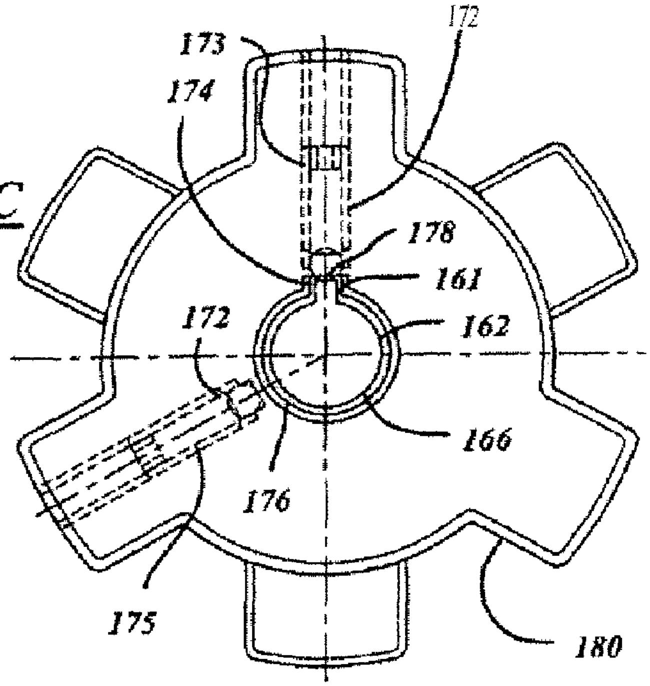


FIG. 4B

FIG. 4C



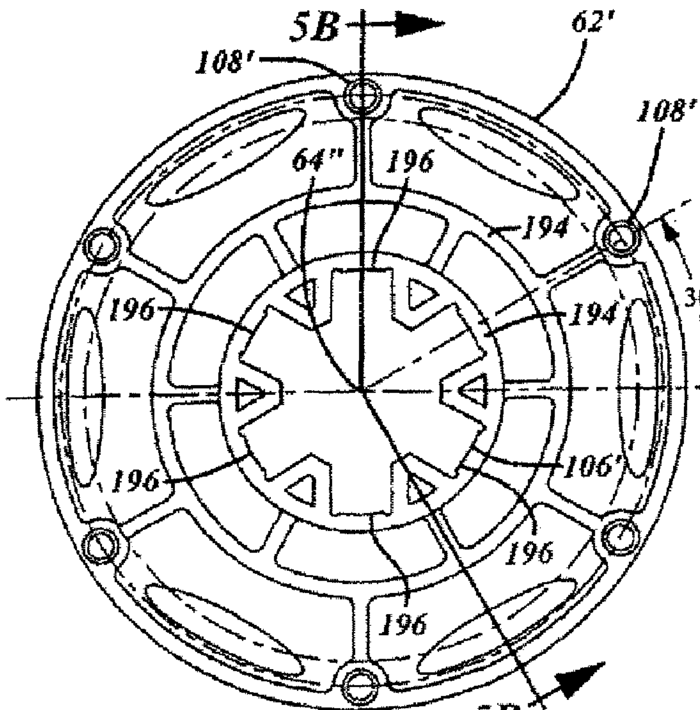


FIG. 5A

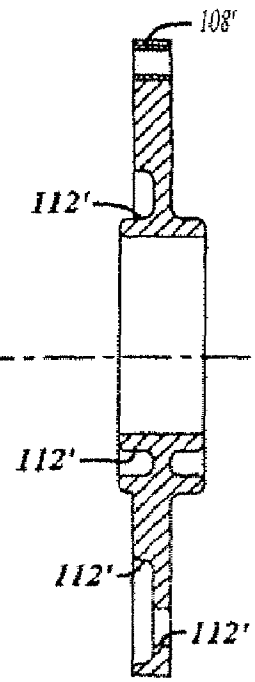


FIG. 5B

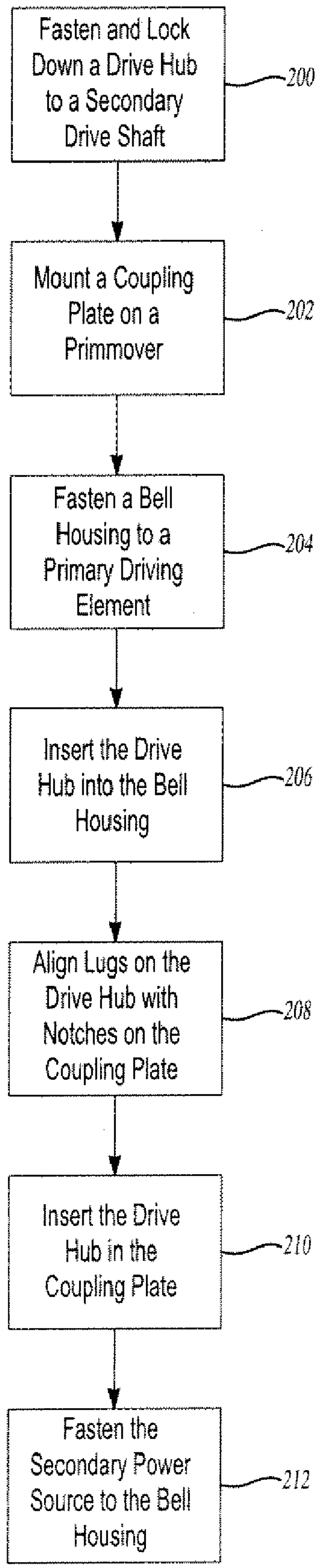

Fasten and Lock Down a Drive Hub to a Secondary Drive Shaft
200
Mount a Coupling Plate on a Primmover
202
Fasten a Bell Housing to a Primary Driving Element
204
Insert the Drive Hub into the Bell Housing
206
Align Lugs on the Drive Hub with Notches on the Coupling Plate
208
Insert the Drive Hub in the Coupling Plate
210
Fasten the Secondary Power Source to the Bell Housing
212

FIG. 6

HUB AND SECONDARY DRIVING ELEMENT SHAFT LOCKING SYSTEM

CROSS-REFERENCE TO RELATED APPLICATION

The present invention claims priority from U.S. Provisional Application No. 60/674,633, filed on Apr. 25, 2005, entitled "Flywheel Coupling Locking Mechanism" and from U.S. Provisional Application No. 60/678,153, filed on May 5, 2005, also entitled "Flywheel Coupling Locking Mechanism".

TECHNICAL FIELD

The present invention relates to flywheel coupling mechanisms, shaft locking mechanisms, and auxiliary driving systems. More particularly, the present invention is related to a coupling hub and locking it to a shaft, which is driven by a flywheel or primemover.

BACKGROUND OF THE INVENTION

In applications where a transmission, a motor, a pump, or other downstream power conversion/transfer medium or secondary power source is utilized, a flywheel coupling mechanism is often incorporated. The flywheel coupling mechanism is typically used as an adaptor between a primary engine and a shaft of an acted upon secondary power source. Rotational energy from the primary engine is transferred through the flywheel to drive the shaft.

Auxiliary drive systems also utilize a similar flywheel coupling mechanism. The auxiliary drive systems are commonly found on off highway, construction, and commercial vehicles for non-transportation purposes. The auxiliary drive systems typically include an auxiliary engine, which is mounted on a vehicle, separate from a primary drive engine, and is used to drive auxiliary pumps, motors, or other equipment. For example, some auxiliary drive systems are used as bucket lifts, cargo lifts, loaders/unloaders, tools, and equipment or material transfer devices.

There are several types of flywheel coupling mechanisms, such as split type couplings and three hole bore operational couplings. Although prior flywheel coupling mechanisms provide for the attachment of a flywheel to a shaft of a secondary power source, they are limited in their ability to lock and maintain a fixed rigid union therebetween. Over time and use, the flywheel coupling mechanisms tend to loosen, allowing components thereof to shift or slide along the shaft. This movement of the flywheel coupling components can result in the disengagement of the shaft relative to the flywheel, thereby, rendering the system inoperable.

It is desirable that a flywheel coupling mechanism be efficient, inexpensive, and provides a strong, durable, and reliable coupling between a flywheel and a shaft of a secondary power source. Thus, there exists a need for an improved flywheel coupling mechanism that overcomes the abovestated limitations.

SUMMARY OF THE INVENTION

One embodiment of the present invention includes a drive coupling hub that has a body and lugs, which extend radially from the body and are engageable with a primemover of a primary power source. The lugs have a fastening lug that includes a radially extending bore. A bearing is set within the bore. A setscrew extends within the bore and applies pressure on the bearing to engage the drive hub to a shaft of a secondary power source.

Another embodiment of the present invention includes a coupling adaptor that transfers energy between a primemover and a shaft of a secondary power source. The coupling adaptor includes a coupling plate and a drive hub. The coupling plate has primemover attachment points, an inner bore, and notches that extend radially inward toward the inner bore. The drive hub has a body and multiple lugs. The body is configured to couple to the shaft. The lugs extend radially from the body and are engageable with the notches.

The embodiments of the present invention provide several advantages. One such advantage is the provision of a shaft locking system that securely locks onto a shaft of a secondary driving element with increased clamping force over prior known techniques.

Another advantage that is provided by an embodiment of the present invention is a coupling adaptor that provides an efficient, inexpensive, and strong locking mechanism for the coupling and transfer of energy between a flywheel or primemover and a secondary driven shaft.

Yet another advantage provided by the embodiments of the present invention is the disclosure of multiple coupling adaptors for the accommodation of different secondary driven shafts including splined and keyed shafts.

Furthermore, the present invention provides coupling adaptors that are quick and relatively easy to manufacture, assemble, and install. The coupling adaptors are versatile and may be sized and adapted for various applications.

The present invention itself, together with further objects and attendant advantages, will be best understood by reference to the following detailed description, taken in conjunction with the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWINGS

For a more complete understanding of this invention reference should now be had to the embodiments illustrated in greater detail in the accompanying figures and described below by way of examples of the invention wherein:

FIG. **1** is a block diagrammatic view of a drive system incorporating a primemover/shaft coupling assembly in accordance with an embodiment of the present invention;

FIG. **2** is a side cross-sectional view of the primemover/shaft coupling assembly incorporating a drive coupling adaptor with a shaft locking system in accordance with an embodiment of the present invention;

FIG. **3**A is a back view of a splined drive hub in accordance with an embodiment of the present invention;

FIG. **3**B is a side cross-sectional view of the splined drive hub of FIG. **3**A through section line **3**B-**3**B;

FIG. **3**C is a front view of the splined drive hub of FIG. **3**A;

FIG. **3**D is a perspective view of the splined drive hub of FIG. **3**A;

FIG. **4**A is a back view of a keyed drive hub in accordance with another embodiment of the present invention;

FIG. **4**B is a side cross-sectional view of the keyed drive hub of FIG. **4**A through section line **4**B-**4**B;

FIG. **4**C is a front view of the keyed drive hub of FIG. **4**A;

FIG. **5**A is a front view of a coupling plate in accordance with an embodiment of the present invention;

FIG. **5**B is a side cross-sectional view of the coupling plate of FIG. **5**A through section line **5**B-**5**B; and

FIG. **6** is a logic flow diagram illustrating a sample method of assembling and installing a primemover/shaft coupling assembly in accordance with an embodiment of the present invention.

DETAILED DESCRIPTION

In the following figures the same reference numerals will be used to refer to the same components. While the present invention is described primarily with respect to a drive system that utilizes a coupling adaptor for the transfer of energy from a flywheel or primemover of an engine to a shaft of a secondary power source, the present invention may be applied in and to various applications. The present invention may be utilized in association with various vehicle and non-vehicle applications. The present invention may apply to automotive, aeronautical, nautical, and railway industries, as well as to other industries that utilize energy transfer couplings between a flywheel or primemover and an acted upon shaft. The present invention may be applied to commercial and to non-commercial applications. Also, a variety of other embodiments are contemplated having different combinations of the below described features of the present invention, having features other than those described herein, or even lacking one or more of those features. As such, it is understood that the invention can be carried out in various other suitable modes.

In the following description, various operating parameters and components are described for one constructed embodiment. These specific parameters and components are included as examples and are not meant to be limiting.

Also, in the following description the term "lug" refers to a radially extending or protruding portion of a hub body. A lug is generally rectangular in shape with significant width. A lug does not refer to spiked or triangularly-shaped teeth that are adjacently placed about a cylindrical object to form a gear or spline. Lugs are generally spaced apart from each other on a body, are less numerous, and are used in different applications than gear teeth or spline teeth.

Referring now to FIG. **1**, a block diagrammatic view of a drive system **10** incorporating a primemover/shaft coupling and housing assembly **12** in accordance with an embodiment of the present invention is shown. The drive system **10** includes a primary driving element **14**, which drives a secondary driving element **16** via the primemover/shaft coupling assembly **12**. The primary driving element **14** and the secondary driving element **16** may be of various types and styles. The primary driving element **14** performs as the original or initial power source and may be in the form of an engine, a combustion engine, an electric motor, a hydraulic motor, a hybrid engine, or in some other form known in the art. The secondary driving source **16** is acted upon by the primary driving element **14** and may also be in the form of a variety of engines or motors, as well as a variety of hydraulic or pneumatic pumps, transmissions, or other secondary power sources or power transfer mediums. In one embodiment of the present invention, the primary driving element **14** is in the form of a combustion engine and the secondary driving element **16** is in the form of a hydraulic pump.

The secondary driving element **16** may be mechanical, electrical, hydraulic, or pneumatic in form or a combination thereof. The secondary driving element **16** may be coupled to and/or incorporated into one or more devices, components, or systems, such as drivetrain elements, vehicle moving elements, auxiliary elements, or the like, which are represented by box **20**. The stated drivetrain/moving/auxiliary elements **20** may include engines **22**, motors **24**, transmissions **26**, drive shafts **28**, axles **30**, compressors **32**, accumulators **34**, lift equipment **36**, loading equipment **38**, material transfer equipment **40**, tools **42**, and other known devices from which power is received from a secondary source of energy. The secondary driving element **16** may be coupled to the drivetrain/moving/auxiliary elements **20** via one or more various known coupling devices, such as hydraulic hoses, air lines, drive shafts, linkages, transfer cases, and unions, which are represented by items, as generally provided by box **50** and lines **52**.

The primemover/shaft coupling assembly **12** includes a flywheel or primemover **54**, a two-piece drive coupling adaptor **56**, and a secondary driving element shaft or secondary driven shaft **58**, which are coupled in series. The drive coupling adaptor **56** attaches the secondary shaft **58** to the primemover **54**. The drive coupling adaptor **56** transfers rotational energy from the primemover **54** to the secondary shaft **58**. The primemover **54** is coupled to the primary driving element **14**. The primemover **54** may be mounted on or attached to a crankshaft or other rotating member **55** of the primary driving element **14**. The secondary shaft **58** is the driving shaft of the secondary driving element **16**.

The drive coupling adaptor **56** includes a drive coupling hub **60** and a coupling plate **62**. The drive hub **60** is mounted on the secondary shaft **58** and is disposed within and engages with the coupling plate **62**. The coupling plate **62** is mounted on the primemover **54**. This is described in further detail below.

Referring now to FIG. **2**, a side cross-sectional view of the primemover/shaft coupling assembly **12** incorporating the drive coupling adaptor **56** with a shaft locking system **57** in accordance with an embodiment of the present invention is shown. The primemover/shaft assembly **12** includes the primemover **54**, the drive coupling adaptor **56**, and the secondary driven shaft **58**, as similarly described above. The primemover **54**, the drive coupling adaptor **56**, and the secondary driven shaft **58** rotate about a longitudinal axis **64** within a bell housing **66**, which is sometimes referred to as a pump mount plate, depending upon the application and the secondary driving element incorporated. The secondary driving element **16** is mounted on the bell housing **66**. Although not shown, the secondary driving element **16** may be attached to the bell housing **66** via threaded fasteners or other suitable fasteners known in the art. The bell housing **66** may contain a cooling or viscous lubricating fluid.

The primemover **54** is circular in shape and has an inner recessed section **68** and an outer ring section **72**. The recessed section **68** is also circular in shape, is on a front side **70** of the primemover **54**, and defines the inner dimensions of the outer ring **72**. The primemover **54** has a first inner set of holes **73**, which are located in the recessed section **68**, and a second outer set of holes **74**, which are located on the outer ring **72**. Primary fasteners **76** extend within and through the first set of holes **73** and thread into a crankshaft base **78** of the primary driving element **14**. The second set of holes **74** are used for attachment of the drive coupling adaptor **56** to the primemover **54**. The primemover **54** may take on other configurations as will be understood by one of skill in the art.

The drive coupling adaptor **56** includes the drive hub **60** and the coupling plate **62**. The drive hub **60** includes a fastening lug **80** and non-fastening lugs (although not shown, similar non-fastening lugs are shown in FIGS. **3**A, **3**C, **3**D). The fastening lug **80** has the shaft locking system **57**, which includes a pair of holes or bores **82**, with a pair of balls or bearings **88** and setscrews **90** therein. The shaft locking system **57** has a pre-locked state and an engaged or locked state. The shaft locking system **57** is shown in the pre-locked state. The pre-locked state refers to when the bearings **88** and setscrews **90** are inserted within the bores **82**, but are not applying pressure on the spline of the drive hub **60** and the secondary shaft **58**, as when in the locked state. This is also the case with the other shaft locking systems disclosed herein. The bores **82** are formed within the fastening lug **80** and have a plurality of inlet openings **84**. The bores **82** extend radially outward from the secondary shaft **58** and perpendicular to the axis of rotation **64**. The drive hub **60** is designed such that the bores **82** are in-line with and over a predetermined or proper portion of the secondary shaft **58**. This portion, as will become more apparent in view of FIGS. **3**A-**4**C, is over a splined or keyed area **86** of the secondary shaft **58**. The bearings **88** are disposed within the bores **82** and are used to apply pressure on an inner circumferential separation wall **91**, which in turn applies pressure on the secondary shaft **58**. This alignment of the bores **82** along with the applied pressure on the bearings **88** on the secondary shaft **58**, assures that the coupling between the drive hub **60** and the secondary shaft **58** is maintained.

The separation wall is disposed between the bearings **88** and the splined area **86**, which includes a spline (the spline is not called out, but a similar spline can be seen in FIGS. **3**A, **3**C, and **3**D). Although the separation wall **91** is not required, its use can prevent damage to the secondary shaft **58**. The wall **91** may be integrally formed as part of the body **120** of the drive hub **60** or may be attached thereto. In one sample embodiment, the thickness T of the wall **91** is approximately 0.025 inches. The thickness T may vary per application.

In the embodiment shown, the setscrews **90** are threaded into the bores **82** and force the bearings **88** against a secondary shaft bore **92** of the drive hub **60**. This causes pressure to be applied on the secondary shaft **58**. The bearings **88** may be metallic and take on different sizes. Note that although two bores, two bearings, and two setscrews are shown; any number of each may be used and incorporated in one or more of the lugs. Also, each lug of the drive hub **60** may contain one or more of the bores, bearings, and setscrews. The setscrews may be fine or coarse threaded. Also, note that one skilled in the art may envision other modified configurations of that disclosed herein, which apply force on the spline and secondary shaft **58** without the use of bearings and/or setscrews and at the same time preventing damage to the spline and the secondary shaft **58**.

The primemover **54** includes an annular section **100**, with an inner portion **102** and an outer portion **104**, and an inner bore **106**. The outer portion **104** has a width W_1 that is smaller that the width W_2 of the inner portion **102**. The outer portion **104** has multiple primemover attachment points (only one is shown in FIG. **2**), which in the embodiment shown are in the form of primemover attachment holes **108**. Primemover fasteners **110** extend through the primemover attachment holes **108** and are threaded into the primemover **54**. The inner bore **106** is configured for reception of the drive hub **60**, which is disposed and engaged therein. To save on material costs and to minimize the weight of the coupling plate **62**, the coupling plate **62** may have cutout sections **112**, such as that shown in the inner portion **102** and the outer portion **104**.

Referring now to FIGS. **3**A-**3**D, a back view, a side cross-sectional view, a front view, and a perspective view of a splined drive hub **60'** are shown in accordance with an embodiment of the present invention. The splined drive hub **60'** is in the form of a toothed wheel and has a generally circular body **120** with a back half **122** and a front half **124**. The back half **122** has six radially extending legs Or lugs **126**, sometimes referred to as teeth, which extend from and are uniformly spaced around the periphery of the body **120**. Three of the lugs **126** are shared with the front half **124**. In the embodiment shown, the lugs are at approximately 60° intervals about the center axis of rotation **64'**. The arrangement of the lugs **126** provides a symmetrical and balanced rotating drive hub. The width W_3 of the back half **122** is smaller than the width W_4 of the front half **124**. The reduced width of the back half **122** reduces the material costs and weight of the drive hub **60'**. Of course, any number of lugs may be used and their sizes, shapes, arrangements and locations may vary. Also, a drive hub may be formed and utilized in which the lugs are not uniformly positioned about the body thereof.

One or more of the lugs **126** are in the form of a fastening lug **80'**. The fastening lug **80'** includes one or more bores **82'**, bearings **88'**, and setscrews **90'** (two of each are shown). As shown, the lugs **126** may be in the back half **122** or the front half **124** or a combination thereof. The front half **124**, generally, refers to the half of a drive hub that is to be mounted closest to a secondary driving element. Although the bores **82'** are in-line with each other along and parallel to the center axis **64'**, which is parallel to the centerline of a secondary shaft (not shown in FIGS. **3**A-**3**C), they may be out of alignment with each other. The bores **82'** have spline sections **132** with first diameters D_1 and setscrew sections **134** with second diameters D_2. The bearings **88'** sit partially within each of the sections **132** and **134**, rest on the flat bottoms **136** of each separation wall **91'**, and are in-line with one of the teeth **138** of the spline **140**. Of course, when desired the bearings may not be in alignment with a single tooth of the spline **140**. The diameters D_1 are larger than the diameter of the bearings D_3 and smaller than the diameters D_2 to allow the bearings **88'** to sit within the spline sections **132**. Each of the bearings **88'** disperses the forces applied over multiple teeth of the spline **140**.

The bores **82'** are threaded and receive the setscrews **90'**. The setscrews **90'** have bearing ends **142** and torque ends **144**. The bearing ends **142** are cupped or concaved shaped to correspond with the shape of the bearings **88'**. The torque ends **144** have recessed sections **146** to allow the insertion of a torque wrench for position adjustment of the setscrews **90'** within the bores **82'** and for applied pressure adjustment on the bearings **88'**.

The drive hub **60'** includes the spline **140**. The spline **140**, as with the lugs **126**, may be attached to or integrally formed as part of the body **120** to form a single unitary structure, as shown. The teeth **138** of the spline **140** correspond to and engage with a similar set of opposing teeth (not shown) on a secondary driven shaft, such as the shaft **58**. Due to the shape of the teeth **138**, the forces exerted thereon are dispersed onto multiple surfaces of the secondary driven shaft. This provides increased clamping force on the secondary driven shaft, which locks the spline **140** to the secondary driven shaft without causing permanent deformation to the secondary driven shaft, the drive hub **60'**, or the spline **140**.

The drive hub **60'** may be formed of a metallic material, such as steel, aluminum, titanium, or other suitable metallic or non-metallic material. The drive hub **60'** may be formed using a machining, sintering, drilling, cutting, molding, casting, or other manufacturing process known in the art.

Referring now to FIGS. **4**A-**4**C, a back view, a side cross-sectional view, and a front view of a keyed drive hub **150** are shown in accordance with another embodiment of the present invention. In the embodiment shown, the keyed drive hub **150** has a body **151** with keyed inner bore **152**, two fastening lugs **154** and **156**, and four non-fastening lugs **157**. The keyed inner bore **152** has a notched or keyed portion **160** that coincides with a key **161** on a secondary driven shaft **162**. The inner bore **152** also has a non-keyed portion **164** that is generally circular in shape, which coincides with the circumferential remainder **166** of the secondary driven shaft **162**.

Each of the two fastening lugs **154** and **156** includes one or more bores **170** (only one per each lug is shown). The bores **170** may be threaded and receive setscrews **172**, similar to the setscrews **90** and **90'**. The bores **170** have a single section with a single diameter D_4. The bores **170** extend to the keyed portion **160** or to the non-keyed portion **164**. The setscrews **172** are screwed into the bores **170** to apply pressure on the keyed portion **160** and on the non-keyed portion **164**. The setscrews **172** may have fiat ends or concave ends, such as the flat end **174** and the concave end **176**, to match the fiat side **178** of the key **161** and the curved shape of the non-keyed portion **164**, respectively, Inner circumferential separation wall or walls **158** (only one is shown) may be incorporated between the setscrews **172** and the secondary driven shaft **162**. It the embodiment shown, a separation wail is not disposed between the key setscrew **173** and the key **161** and a separation wail is disposed between the shaft setscrew **175** and the secondary driven shaft **162**.

In the embodiment shown, the drive hub **150** has a back half **179** and a front half **180**. The bores **170** are located in the front half **180** of the drive hub **150** and are approximately 120° apart from each other. Of course, any number of bores may be utilized and the bores maybe located in any of the lugs **157** and in either of the halves **179** and **180**. Note also that the bores **170** may extend frilly through the drive hub **150** into the keyed inner bore **152** as shown, or up to one of the walls **91"**. Thus, the setscrews **172** may be screwed into the keyed inner bore **152** and directly apply pressure on the secondary driven shaft **162** or may apply pressure on the walls **158**, thereby, in directly applying pressure on the secondary driven shaft **162**.

The keyed drive hub **150** may be formed of similar materials as the splined drive hub **60'**. The keyed drive hub **150** may also be of various sizes, shapes, and styles, as well as have any number of lugs, bores, setscrews, keyed portions, and non-keyed portions. Also, for both the keyed drive hub **150** and the splined drive hub **60'**, fasteners other than the setscrews **90'** and **172** may be used and they may extend within the bodies of the drive hubs in areas other then in alignment with and in the lugs thereof. For example, one or more fasteners (not shown) may extend radially through the body **190** of the drive hub **150**, in the front half **180**, and not within and between the lugs **157** such that the heads or exposed portions thereof are between and do not protrude radially outward away from the body **190** past the lugs **157**.

Referring now to FIGS. **5A-5B**, a front view and a side cross-sectional view of a coupling plate **62'** are shown in accordance with an embodiment of the present invention. The coupling plate **62'** is shown as a flat toroidally-shaped or annular disc with an inner bore **106'**.

The coupling plate **62'** has fastening points **108'** that are shown as openings or holes, which allow for the extension of primemover fasteners therethrough. The coupling plate **62'** also has cutouts **112'** of varying size and shape, some of which are in the form of grooves **194**. The cutouts **112'** are uniformly dispersed about the coupling plate **62'** to provide balance. The coupling plate **62'** may take on a variety of shapes, sizes, and layouts. The coupling plate **62'** may also be formed of metallic or non-metallic materials. In one embodiment, the plate is formed of plastic.

The inner bore **106'** has multiple notches **196** that extend radially inward towards and are open to the inner bore **106'**. The notches **196** are in the form of axial channels that extend longitudinally along and are uniformly arranged around the axis of rotation **64"**, and are inwardly open to the inner bore **106'**. The notches **196** correspond in size and shape to and receive and engage with the lugs of a drive hub, such as the lugs **126**, **154**, **156**, and **157**. Thus, the number size and orientation of the notches **196** matches that of the associated lugs. The sizes and shapes of the lugs **126**, **154**, **156**, and **157** and the notches **196** may vary per application.

Referring now to FIG. **6**, a logic flow diagram illustrating a sample method of assembling and installing a primemover/shaft coupling assembly in accordance with an embodiment of the present invention is shown.

In step **200**, a drive hub, such as one of the drive hubs **60**, **60'**, and **150** is fastened and locked down to a secondary driven shaft of a secondary driving element, as described above.

In step **202**, a coupling plate, such as the coupling plate **62** and **62'**, is mounted onto a primemover. In step **204**, an engine bell housing or pump mount plate, such as the bell housing **66**, is placed over the primemover and the coupling plate and is fastened to a primary driving element.

In step **206**, the drive hub with the secondary driven shaft attached thereto is inserted into the bell housing. In step **208**, the lugs on the drive hub are aligned with the notches on the coupling plate. In step **210**, the drive hub is inserted within the inner bore of the coupling plate. The lugs, such as the lugs **126**, **154**, **156**, and **157**, are inserted within the notches of the coupling plate, such as the notches **196**. In step **212**, the secondary power source is fastened to the bell housing or rigidly held thereto.

The above-described steps are meant to be illustrative examples; the steps may be performed sequentially, synchronously, simultaneously, or in a different order depending upon the application and desired implementation.

While the invention has been described in connection with one or more embodiments, it is to be understood that the specific mechanisms and techniques which have been described are merely illustrative of the principles of the invention, numerous modifications may be made to the methods and apparatus described without departing from the spirit and scope of the invention as defined by the appended claims.

What is claimed is:

1. A drive coupling hub for engagement with a shaft of a secondary power source to transfer energy from a primary driving element, comprising:

a body portion having an inner periphery, said inner periphery being engageable with the shaft of the secondary power source, said body portion intended to communicate with a primary driving element to effectuate rotation thereof;

at least one radially extending bore formed in said body portion, said bore having an end adjacent said inner periphery;

at least one bearing within said at least one radially extending bore, said at least one bearing being located at said end adjacent said inner periphery;

a separation wall disposed between said at least one bearing and said inner periphery to prevent direct contact between said at least one bearing and the drive shaft; and

at least one device extending within said at least one radially extending bore and applying pressure to said at least one bearing, which applies pressure to said separation wall, and to the shaft of the secondary power source that is received within said inner periphery to effectuate constant engagement between the hub and the shaft.

2. The hub of claim **1**, wherein said body portion includes a plurality of lugs that extend radially outward away from said inner periphery, each of said plurality of lugs are uniformly spaced from one another.

3. The hub of claim **2**, wherein said plurality of lugs comprises six symmetrically arranged lugs.

4. The hub of claim **2**, wherein said inner periphery of said body portion is splined.

5. The hub of claim **2**, wherein said at least one radially extending bore is formed in one of said plurality of lugs.

6. The hub of claim **5**, further comprising:

a plurality of radially extending bores in at least one of said plurality of lugs.

7. The hub of claim **5**, further comprising:

a second radially extending bore formed in another of said plurality of lugs.

8. The hub of claim **7**, further comprising:

a second bearing disposed in an end of said second radially extending bore adjacent said inner periphery and a second device disposed in said second radially extending bore to apply pressure to the shaft.

9. The hub of claim **2**, wherein said body portion includes a front half and a back half with each said plurality of lugs extending from at least said back half, while less than each of said plurality of logs extend from said front half.

10. The hub of claim **1**, wherein said separation wall has a substantially flat inner surface.

11. The hub of claim **1**, wherein said at least one securing device is a set screw.

12. The hub of claim **11**, wherein said set screw includes a bearing end and a torque end, said bearing end being generally cup-shaped to substantially conform to the shape of said at least one bearing.

13. A drive coupling hub for engagement with a shaft of a secondary power source, comprising:

a body potion having an inner periphery and an outer periphery, said body portion consisting of a plurality of uniformly spaced outwardly extending lugs;

said body potion being engageable with the shaft of the secondary power source to effectuate rotation thereof;

at least one radially extending bore formed in at least one of said plurality of lugs, said at least one bore having an open end adjacent said outer periphery and a closed end adjacent said inner periphery, said closed end having a substantially flat bottom surface;

at least one bearing within said at least one radially extending bore, said at least one bearing being located at said end adjacent said inner periphery and resting on said substantially flat bottom surface;

at least one securing device disposed within said at least one radially extending bore for applying pressure to said at least one bearing and to the shaft of the secondary power source that is received within said inner periphery to effectuate constant engagement between the hub and said drive shaft;

whereby the drive hub is securely engaged to the shaft while minimizing damage to the shaft.

14. The hub of claim **13**, wherein said plurality of lugs comprises six symmetrically arranged lugs.

15. The hub of claim **13**, wherein said inner periphery of said body portion is splined.

16. The hub of claim **13**, wherein said at least one securing device is a set screw.

17. The hub of claim **16**, wherein said set screw includes a bearing end and a torque end, said generally cup shaped to substantially conform to the shape of said at least one bearing.

18. The hub of claim **13**, wherein said at least one radially extending bore is formed in one of said plurality of lugs.

19. The hub of claim **13**, further comprising:

a second radially extending bore formed in another of said plurality of lugs.

20. The hub of claim **19**, further comprising:

a second bearing disposed in an end of said second radially extending bore adjacent said inner periphery and a second device disposed in said second radially extending bore to apply pressure to the shaft.

21. A drive hub for engaging a shaft of a secondary power source and control operation thereof comprising:

a body portion having a plurality of lugs extending outwardly therefrom;

an inner bore formed through said body portion and having a periphery, said inner bore being large enough to accommodate the shaft of the secondary power source therethrough, said periphery intended to engage the shaft of the secondary power source;

a radially extending bore formed in at least one of said plurality of lugs, said bore having a closed interior end defined by a partition wall that separates said bore from said periphery and an open outer end;

at least one substantially round bearing disposed in said bore and in contact with said partition wall;

at least one securing device located within said bore and having a torque end and a bearing end that contacts a surface of said at least one bearing;

whereby said securing device is intended to apply pressure to said at least one bearing to cause said periphery to contact and secure the shaft of the secondary power source to effectuate rotation thereof as needed.

22. The hub of claim **21**, wherein said plurality of lags are uniformly spaced from one another about an outer periphery of said body portion.

23. The hub of claim **22**, wherein said plurality of tugs comprises six symmetrically arranged lugs.

24. The hub of claim **21**, wherein said periphery is keyed to effectuate secure engagement between the hub and the shaft.

25. The hub of claim **21**, wherein said separation wall has a substantially flat inner surface.

26. The hub of claim **25**, wherein said at least one securing device is a threaded device.

27. The hub of claim **26**, wherein said at least one securing device is a set screw.

28. The hub of claim **27**, wherein aid bearing end of mid set screw is generally cup shaped to substantially conform to the shape of said at least one bearing.

29. The hub of claim **21**, wherein said body portion includes a front half and a back half with each said plurality of lugs extending from at least said back half, while less than each of said plurality of lugs extend from said front half.

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