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HUB STRUCTURE FOR AN AERONAUTICAL PROPELLER

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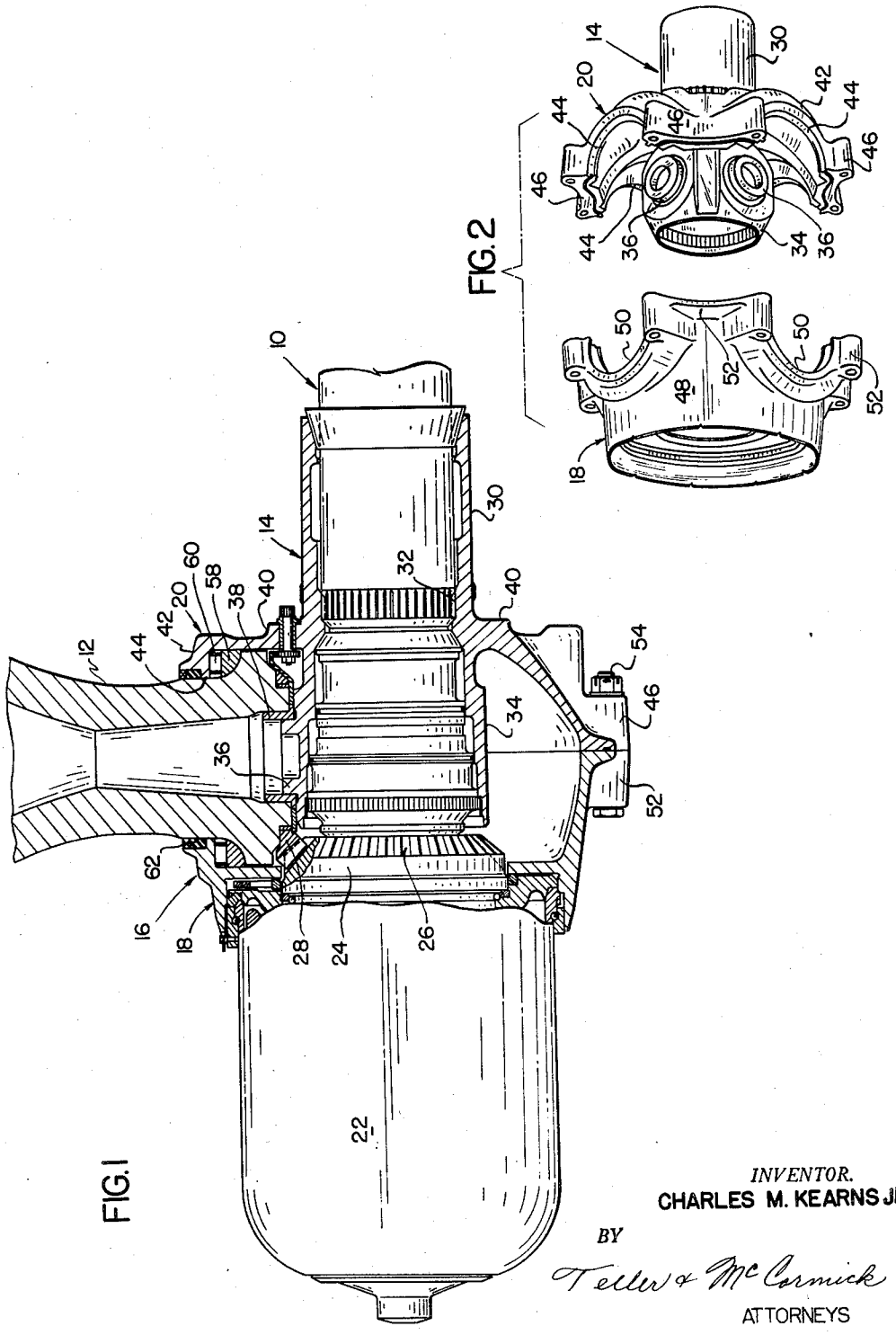

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HUB STRUCTURE FOR AN AERONAUTICAL PROPELLER

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This invention relates to an improved hub structure for an aeronautical propeller and, more specifically, to an improved spider and barrel construction for a hub.

It is the general object of the invention to provide an aeronautical propeller hub wherein the spider and barrel members thereof are characterized by their lightweight, metal-saving form, one-half of the barrel being formed integrally with the spider in a construction which increases the torque transmitting characteristics of the hub and which is stronger and better able to withstand the stress of operation for longer periods of time than any spider and barrel construction heretofore known and used.

The drawing shows a preferred embodiment of the invention and such embodiment will be described, but it will be understood that various changes may be made from the construction disclosed, and that the drawing and description are not to be construed as defining or limiting the scope of the invention, the claims forming a part of this specification being relied upon for that purpose.

Of the drawing:

Fig. 1 is a view partially in section through the hub of an aeronautical propeller incorporating the features of the present invention; and

Fig. 2 is an exploded perspective view of the spider and barrel which feature the hub structure of this invention.

Referring to the drawing in detail, the reference numeral **10** indicates generally the propeller shaft defining the axis of an aeronautical propeller assembly which includes radial propeller blades, such as the blade **12**. It has long been the practice to transmit torque from the propeller shaft to the propeller blades in a hub which includes an element or member commonly called a "spider" which embraces and is connected to the shaft and which has arms extending into the hollow interior of the root section of the blades. It has also been an established practice to provide as a part of the hub structure an element or member commonly referred to as a "barrel" which is formed in two halves for connection around the inboard or root end portions of the propeller blades to retain them in engagement with the spider so that they are rotated with the propeller shaft. In these prior constructions, the barrel elements transmitted little, if any, torque from the shaft to the blades, the barrel elements being used solely for the purpose of retaining the blades. In accordance with the present invention, one-half of the barrel construction is formed integrally with the spider so that the barrel transmits part of the torque or load from the propeller shaft to the blades, permitting a weight-saving and economical change in the spider construction while at the same time providing for greater over-all strength in the hub structure.

As shown in the drawing, the spider is indicated generally by the reference numeral **14** and the barrel is designated generally by the numeral **16**, the said barrel comprising two halves **18** and **20**, the rear or inboard half **20** being formed integrally with the spider **14**. As was the

case with the prior structures, the hub provided in accordance with the present invention is designed to accommodate the pitch changing mechanism and other devices associated with a controlled pitch propeller capable of being feathered and placed in reverse pitch. The pitch changing mechanism which is suported by the hub structure is located forwardly thereof within a propeller dome **22**. The details of the pitch changing mechanism form no part of the present invention and such mechanism may vary considerably as to detail. A preferred pitch changing mechanism is hydraulically operated and of the general type shown in the Caldwell, Martin and Anderson Patent 2,174,717 to which reference may be had for a detailed disclosure of the mechanism.

Included in the pitch changing mechanism as shown in the aforementioned patent and as shown by way of example in the accompanying drawing is a rotatable cam **24** which is rotated on the propeller axis in one direction and the other when the pitch changing mechanism calls for a change in the propeller blades toward high and low pitch, respectively. Bevel gear teeth **26** are provided on the inboard end of the cam **24** and are in continuous engagement with the teeth on a gear ring or segment **28** connected to the inner end of each propeller blade **12**. Thus, in operation of the pitch changing mechanism within the dome **22**, the cam **24** is rotated on the propeller axis to effect rotation of the propeller blades, all in the same direction and to the same degree on their respective pitch change axes which are in a common plane at substantially a right angle to the propeller shaft axis.

The spider **14** has a susbtantially cylindrical rear end portion **30** surrounding the propeller shaft **10** and connected thereto as by a splined connection indicated at **32**. The front end portion **34** of the spider is also generally cylindrical, but it has formed thereon a plurality of radially extending arms **36, 36** which are equally circumaxially spaced and which correspond in number to the propeller blades, a four-blade installation being shown. Each radial arm **36** is preferably cylindrical in form, and in the assembled propeller, each arm extends into a bushing **38** disposed in the hollow inner end of a propeller blade **12**. It is important to observe that the arms **36, 36** are short by comparison with the conventional spider arms as shown, for example, in the aforementioned Caldwell et al. Patent No. 2,174,717. The short spider arm structure made possible by the present invention provides for economy and ease in manufacture, and, more importantly, there is a substantial saving in weight in the finished structure without sacrifice of strength.

The weight-saving short spider arm construction is accommodated in accordance with the present invention by providing the rear or inboard barrel half **20** as an integral part of the spider **14**. That is, in the preferred form, the rear barrel half **20** is formed as a radially outwardly extending skirt-like wall **40** on the generally cylindrical rear portion **30** of the spider. The rear barrel half **20** has a forwardly projecting flange **42** wherein there is provided a plurality of forwardly facing semi-circular openings **44, 44** which are equal in number to the spider arms **36, 36** and similarly circumaxially spaced. In the example shown, there are four semi-circular openings **44, 44** to accommodate four propeller blades. In addition, there are four radial connecting flanges and bosses **46, 46** defined on the front face of the forwardly extending flange **42**, one such flange and boss being provided between adjacent semi-circular blade-receiving openings **44, 44**.

The front barrel half or section **18** is generally similar and complementary to the aforedescribed rear barrel half **20**. The said front barrel half has a forwardly projecting generally cylindrical portion **48** which receives the rear end of the propeller dome **22**. It also has a radial

and rearwardly facing skirt or flange provided with a plurality of substantially semi-circular openings **50, 50** similar to the blade-receiving openings **44, 44** on the rear half of the barrel as described above. In the example shown, there are four openings **50, 50** equally circumaxially spaced around the front barrel half **18** and opposed to the openings **44, 44** in the rear barrel half **20**. A radial connecting flange and boss **52** is provided between each pair of adjacent openings **50, 50** for engagement with the corresponding flange and boss **46** on the rear barrel half **20**. Thus, when the front and rear barrel halves are engaged substantially in the plane of the propeller blades and they are connected as shown in Fig. 1, the openings **44, 44** and **50, 50** on the respective barrel halves define circular openings within which the inner end portions of the propeller blades **12, 12** are received and retained. The barrel halves are secured in engagement by through bolts and nuts as indicated at **54**, the said bolts passing through the connecting flanges and bosses **46** and **52**.

Now, it will be observed that in addition to being hollow to receive the spider arms, the inner end portions of the propeller blades are provided with radial flanges. The blade flanges may properly be referred to as retaining flanges in that said flanges cannot be withdrawn through the blade-embracing circular openings defined by the connected barrel halves. That is, the forwardly projecting flange **42** on the rear barrel half wherein the semi-circular openings **44, 44** are defined and the rearwardly projecting flange on the front barrel half wherein the semi-circular openings **50, 50** are defined overlie the blade flanges.

Therefore, in order to accommodate assembly of the blades with the rear barrel half and spider, it is necessary to have the forwardly projecting flange **42** on said rear barrel half spaced radially outwardly from the ends of the spider arms **36, 36**. In actual assembly, a blade **12** is placed over a spider arm **36** and then the two halves of a thrust bearing ring **58** are placed around the blade between the blade flange and barrel flange **42**. Then, a plurality of bearings **60, 60** are located between the thrust bearing **58** and the barrel flange **42**. And, finally, the front barrel half **18** is placed in position and connected to the rear half **20** by the through bolts and nuts **54, 54**. A sealing gasket or packing **62** is preferably provided in a suitable groove in the assembled barrel around each blade.

Obviously, assembly of the blades to the hub and shaft is made more simple by this invention. Less obviously, the hub is of less weight than prior constructions due to the reduction in size of the spider arms, this being possible by forming one-half of the barrel as an integral part of the spider whereby the said one-half of the barrel shares the torque transmitting function of the spider arms.

The invention claimed is:

1. A hub for retaining a plurality of radial aeronautical propeller blades, each of which has a radial flange on its inner end, and for transmitting torque from a shaft on the propeller axis to the blades and comprising, a spider having a generally cylindrical portion embracing and connected to the shaft and having a plurality of radial arms corresponding in number to and which are received within the inner ends of the blades, and a barrel comprising front and rear halves which engage substantially in the plane of the blades, the front half having a rearwardly projecting flange provided with substantially semi-circular openings facing rearwardly and with radial connecting flanges disposed therebetween and the rear half having a forwardly projecting flange provided with complementary substantially semi-circular openings facing forwardly and with complementary, radial connecting flanges disposed therebetween, whereby by engaging and connecting the radial flanges of the respective barrel halves the blades are surrounded and retained within the circular openings of the connected barrel with the forwardly and rearwardly projecting flanges on the barrel halves overlying the flanges of the respective blades, and the rear half of the barrel being formed integrally with the cylindrical portion of the spider and with its forwardly projecting flange spaced radially outwardly from the spider arms to accommodate blade assembly.

2. A hub for retaining a plurality of radial aeronautical propeller blades, each of which has a radial flange on its inner end, and for transmitting torque from a shaft on the propeller axis to the blades and comprising, a spider having a generally cylindrical portion embracing and connected to the shaft and having a plurality of radial arms corresponding in number to and which are received within the inner ends of the blades, and a barrel comprising front and rear halves which engage substantially in the plane of the blades, the front half having a rearwardly projecting flange provided with substantially semi-circular openings facing rearwardly and with radial connecting flanges disposed therebetween and the rear half having a forwardly projecting flange provided with complementary substantially semi-circular openings facing forwardly and with complementary radial connecting flanges disposed therebetween, whereby by engaging and connecting the radial flanges of the respective barrel halves the blades are surrounded and retained within the circular openings of the connected barrel with the forwardly and rearwardly projecting flanges on the barrel halves overlying the flanges of the respective blades, bearing means interposed between each blade flange and the overlying flanges of the barrel halves, and the rear half of the barrel being formed integrally with the cylindrical portion of the spider and with its forwardly projecting flange spaced radially outwardly from the spider arms to accommodate blade assembly.

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