June 9, 1931. O. FAHLIN 1,808,888

PROPELLER

Filed Dec. 28, 1929

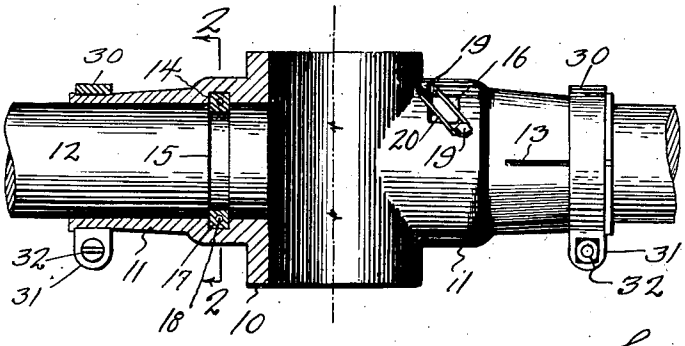

Fig. 1

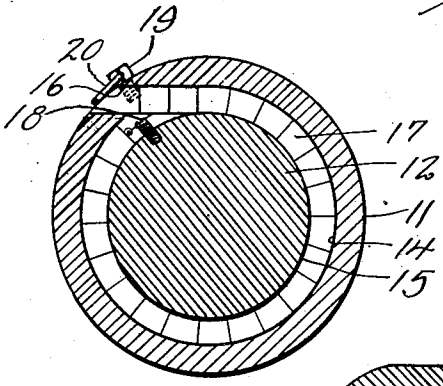

Fig. 2

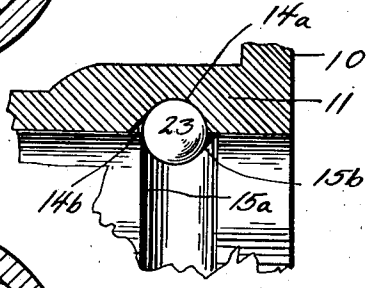

Fig. 5

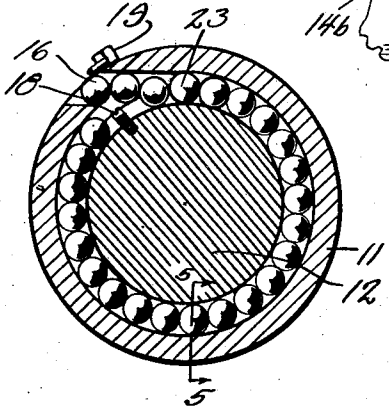

Fig. 4

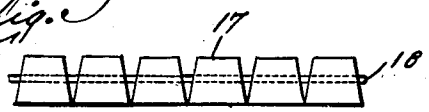

Fig. 3

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UNITED STATES PATENT OFFICE

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PROPELLER

Application filed December 26, 1929. Serial No. 417,090.

My invention relates to propellers of the all metal, removable blade variety and has for its object to provide an improved and simplified hub and blade shank construction having all the strength, durability and other requirements of a propeller for use in heavier than air machines.

An object of my invention is to provide a propeller construction in which the hub may be made in a single piece to provide a central hub proper and a pair of sockets to receive the blade shanks. The biggest problem encountered in providing a removable propeller blade construction is that of securing the blades against the action of centrifugal force.

Another problem is that of balancing the blades in the hub so that the propeller will be perfectly balanced on its axis. This problem exacts a rigid requirement that the blades shall not slip longitudinally in their sockets.

Another desirable feature of a removable blade propeller is that the blades be adjustable about their longitudinal axis to change or adjust their pitch. This requires a round or at least a partially round socket and an efficient clamping device is required to secure the blade shank in its adjusted position with such a socket.

My invention aims to solve all of the above problems and to embody the above mentioned features in a propeller having a one-piece hub. The above requirements then create a problem in connection with the insertion and removal of the blade shanks from their sockets. Set screws, bolts and pins are entirely inadequate for the purpose of securing the blades against longitudinal displacement from their sockets. The most satisfactory means for connecting the blade shank to its socket is the construction embodying coacting devices extending entirely around the exterior and interior of shank and socket respectively. For example, in prior constructions, the blade shank is formed with an integral, radially protruding, annular flange adapted to be received in an interior, annular depression formed in the socket adjacent the center of the hub and larger than the inner diameter of the outer portion of the socket. To employ such a construction, it is necessary to form the sockets in halves, which may be separated to allow insertion of the blade shanks.

Making the hub in two pieces requires a larger number of parts; requires additional securing devices for holding the two halves of the hubs together; makes a weaker structure than can be had in a one-piece hub of the same dimensions and material and makes it more difficult to properly balance the propeller.

My invention further contemplates a construction in which the blade sockets are adapted to snugly engage the entire peripheries of the blade shanks so as to obtain a maximum gripping action against the shanks when the clamps are tightened.

Another object is to provide a construction in which, if desired, only a single slot may be provided in each blade socket to allow the necessary contraction of the socket wall for tightening against the blade shank. A single slotted socket is stronger than a double slotted socket.

Furthermore, with respect to the making of the sockets substantially completely inclosed, a stronger construction is provided than that type of construction which embodies a pair of widely spaced arms occupying only a portion of the periphery of the cylindrical surface which they define.

With these and other objects in view, my invention consists in the construction, arrangement and combination of the various parts of my device, whereby the objects contemplated are attained, as hereinafter more fully set forth, pointed out in my claims, and illustrated in the accompanying drawings, in which:

Fig. 1 is a combined, sectional view and side elevation of the hub and shank assembly.

Fig. 2 is a detail, sectional view taken on the line 2—2 of Fig. 1.

Fig. 3 is a detail view of the flexible key.

Fig. 4 is a view similar to Fig. 2 of a modified form of the invention, and

Fig. 5 is a detail, sectional view taken on the line 5—5 of Fig. 4.

I have used the reference character 10 to indicate the hub proper or shaft receiving portion of the hub of my propeller. Any of the conventional devices for splining, keying, or otherwise securing the hub upon the motor shaft of an aeroplane may be employed and no particular means to this end is illustrated herewith. The hub 10 and a pair of diametrically opposed sockets 11 are formed of a single piece of metal forged and machined to the proper shape and dimensions. Each socket 11 is substantially cylindrical in shape, providing interior cylindrical surfaces or bores adapted to snugly receive the shank 12 of a propeller blade. The interior surface of the socket might be slightly conical without departing from the spirit of my invention, although the easiest method of machining it is to mill it to a strictly cylindrical shape.

The cylindrical surface is broken only by a narrow slot or slots 13, which allow contraction of the sockets.

That portion of the socket adjacent the hub proper 10 is provided with an interior, annular recess 14. The shank 12 near its end is provided with an annular recess 15, adapted to register with the recess 14.

A flexible key or a series of key elements is adapted to be inserted into the ring shaped space formed between the two recesses 14 and 15 and the socket wall is provided with an opening 16 to allow such insertion. One method of construction is to employ a series of parallel sided blocks 17, connected by a wire or the like 18 to form a flexible key or chain of blocks. The opening 16 is positioned tangentially relative to the ring shaped cavity formed by the recesses 14 and 15 and the flexible key is inserted by simply pushing it through the opening.

A screw 18 is secured in the shank 12 within the recess 15 and flush with or below the surface of the shank. The function of the screw 18 is to remove the key from its recess. This is accomplished by grasping the propeller blade with the hands and twisting it in such a direction that the screw 18 will engage the inner end of the key. Rotation of the shank will then force the key out of the recess. It will be understood that any sort of projection positioned below the surface of the shank and within the recess 15 might be employed for this purpose.

The key is of such a length as to fill the opening 16 and thus to close it against the entrance of moisture. To this end a snug fit is provided between the end block of the key and the opening 16. In order to provide a smooth finish, the end block may be cut with an inclined face to register with the inclination of the surface of the socket 11 adjacent the opening 16.

The key is held in place by a wire 20, which is threaded through openings in a pair of studs 19, secured in the socket 11 on either side of the opening 16, as shown in Fig. 1. The parts will be so arranged that if by any chance the clamping mechanism for holding the blade against rotation in its socket should fail during flight, the rotational pressure against the blade will cause the screw 18 to move in an opposite direction which results in removal of the key from its recess. Otherwise the pressure might be sufficient to break the wires 20 and remove the key, whereupon the propeller blade would become lost and result in a very serious accident to the aeroplane.

By accurately forming the blades and blade shanks and sockets symmetrically with exactly the same dimensions for each relative part, the balancing of the propeller is an easy matter. The blocks 17 will have uniform thickness between their working faces (the faces shown in plan in Fig. 3) and will automatically cause the blades to assume positions exactly the same distance from the rotational axis of the propeller hub.

Instead of the flexible key shown in Fig. 3, a series of steel balls 23 might be employed, being inserted by pushing them one at a time through the opening 16. The balls 23 will coact with the screw 19 and screw 18 in the same manner as described for the flexible key and all of the functions of the combination of flexible key and the screws 18 and 19 may be derived from the combination of the balls 23 with the screws 18 and 19.

Another function which may be given to the balls 23 is that of forming a wedging connection between the shank 12 and the socket. To this end, the recess 15*a* of the shank has its side adjacent the end of the shank inclined as at 15*b* in Fig. 5 and the recess 14*a* of the socket has its opposite side inclined as at 14*b*. The pull between the shank and the socket is transmitted between the faces 14*b*, the balls 23 and the faces 15*b*. Since the pull is in a direction at an angle to the inclined faces 15*b* and 14*b*, the effect of this pull will be to set up a series of radial forces in which the balls 23 tend to force the adjacent portions of the shank and socket away from each other. The result is a wedging action which is distributed uniformly around the periphery of the shank, acting at all points in a radial direction and thereby serving to accurately center the shank within the socket as well as to tightly wedge it in place. The centering action is of importance in view of the necessity of providing sufficient clearance between the shank and the socket adjacent the hub to allow the shank to enter the solid ring of ma-

terial comprising that portion of the socket.

A slight resiliency in the outer extremities of the sockets enables them to be compressed so as to firmly grip the shanks and the same clearance may be observed through the entire length of each socket. The compression of the sockets is accomplished by a pair of clamping rings 30, each of which is split and provided with parallel ears 31, connected by clamping bolts 32.

It will be understood that the slots 13 may either be provided singly or in pairs, the former having the advantage of increasing the strength of the sockets and the latter having the advantage of increasing the accuracy of centering of the shanks within the sockets.

Some changes may be made in the construction and arrangement of the parts of my invention without departing from the real spirit and purpose of my invention, and it is my intention to cover by my claims any modified forms of structure or use of mechanical equivalents, which may be reasonably included within their scope.

I claim as my invention:

1. In an aeroplane propeller, a hub comprising a hub proper and sockets formed integrally therewith, each socket being provided with an internal annular recess, a blade shank received in the socket and formed with an annular recess registering with the socket recess to form therewith an annular space, the socket wall having an aperture communicating with said space, means insertible through said aperture and received in said space for transmitting longitudinal pull of the shank to the socket, and means to clamp the socket into gripping engagement with the shank.

2. In an aeroplane propeller, a hub comprising a hub proper and sockets formed integrally therewith, each socket being provided with an internal annular recess positioned near said hub proper, a blade shank received in the socket and formed with an annular recess registering with the socket recess to form therewith an annular space, the socket wall having an aperture communicating with said space, means insertible through said aperture and received in said space for transmitting longitudinal pull of the shank to the socket, and means positioned near the end of the socket to clamp the socket into gripping engagement with the shank.

3. In an aeroplane propeller, a hub comprising a hub proper and cylindrical sockets formed integrally therewith, each socket being provided with an internal annular recess, a blade shank received in and shaped to fit snugly within the socket and formed with an annular recess registering with the socket recess to form therewith an annular space, the socket wall having an aperture communicating with said space, means insertible through said aperture and received in said space for transmitting longitudinal pull of the shank to the socket, and means to clamp the socket into gripping engagement with the shank.

4. In an aeroplane propeller, a hub comprising a hub proper and sockets formed integrally therewith, each socket being provided with an internal annular recess, a blade shank received in the socket and formed with an annular recess registering with the socket recess to form therewith annular space, the socket wall having an aperture communicating with said space, means insertible through said aperture and received in said space for transmitting longitudinal pull of the shank to the socket, and means to secure the shank against rotation in the socket.

5. In an aeroplane propeller, a hub comprising a hub proper and sockets formed integrally therewith, each socket being provided with an internal annular recess, a blade shank received in the socket and formed with an annular recess registering with the socket recess to form therewith an annular space, the socket wall having an aperture communicating with said space, means to secure the shank against rotation in the socket, and means insertible through said aperture and received in said space for transmitting longitudinal pull of the shank to the socket, said means comprising a series of shear-resisting elements and a flexible tie member to which said elements are attached.

6. In an aeroplane propeller, a hub comprising a hub proper and sockets formed integrally therewith, each socket being provided with a substantially unbroken cylindrical bore and with an internal annular recess, a blade shank received in and shaped to fit snugly within the socket and formed with an annular recess registering with the socket recess to form therewith an annular space, the socket wall having an aperture communicating with said space, means insertible through said aperture and received in said space for transmitting longitudinal pull of the shank to the socket, and means to clamp the socket into gripping engagement with the shank.

7. In an aeroplane propeller, a hub comprising a hub proper and sockets formed integrally therewith, each socket being provided with an internal annular recess positioned near said hub proper, a blade shank received in the socket and formed with an annular recess registering with the socket recess to form therewith an annular space, the socket wall having an aperture communicating with said space, means insertible through said aperture and received in said space for transmitting longitudinal pull of the shank to the socket, the socket being ex-

tended at a substantial distance beyond said space to give lateral support to the shank and means to secure the shank against rotation in the socket.

Signed this 23rd day of December, 1929, in the county of Woodbury and State of Iowa.

OLE FAHLIN.