H. LEITNER.

SCREW PROPELLER.

APPLICATION FILED NOV. 4, 1920.

Patented May 2, 1922.

5 SHEETS—SHEET 1.

1,414,742.

Fig.3.

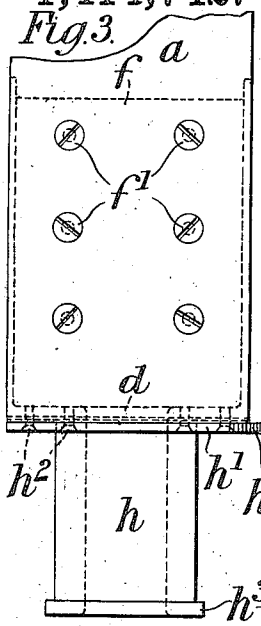


Fig.4.

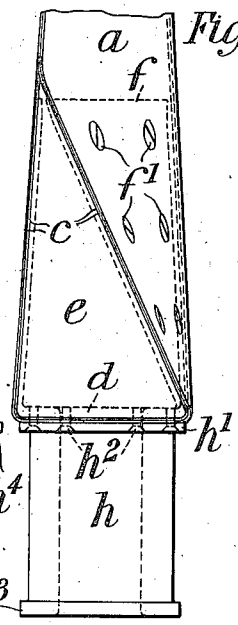


Fig.6.

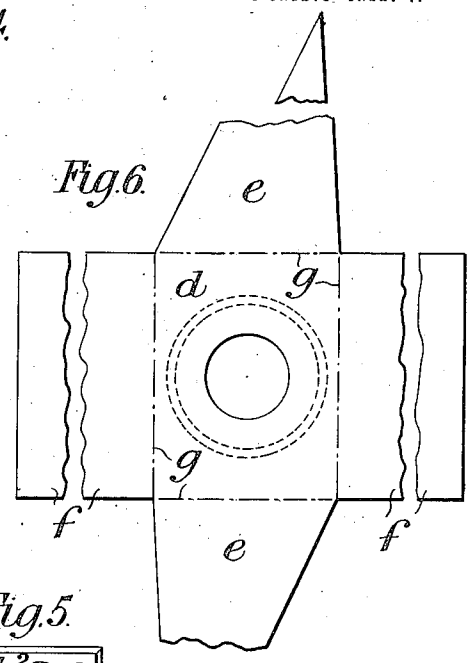


Fig.5.

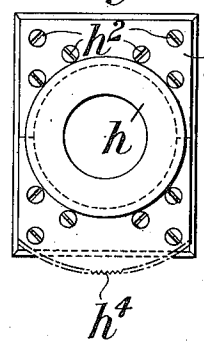


Fig.1.

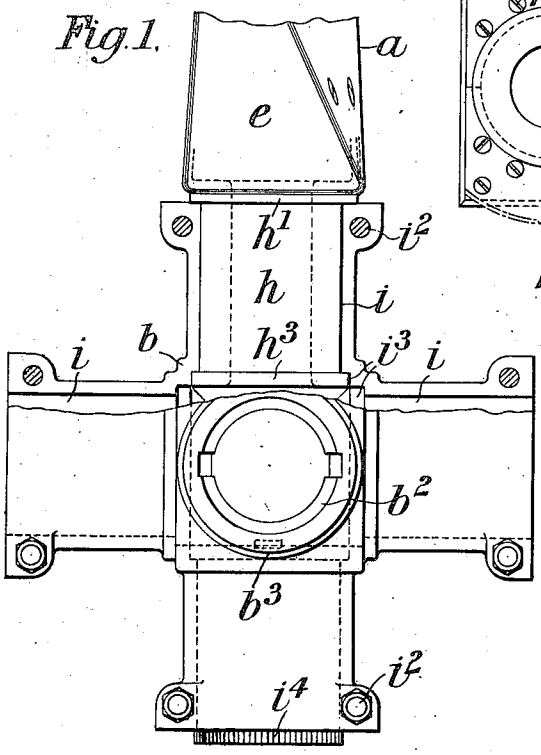
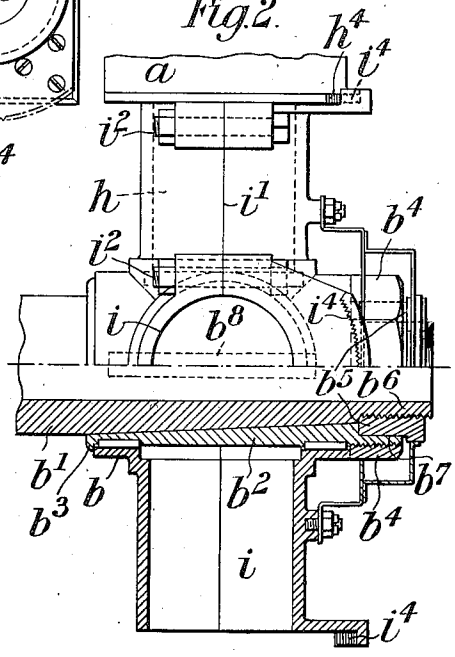


Fig.2.



Inventor Hanns Leitner

Künzel & Schmidt Atty.

H. LEITNER.

SCREW PROPELLER.

APPLICATION FILED NOV. 4, 1920.

1,414,742.

Patented May 2, 1922.

5 SHEETS—SHEET 2.

Fig. 7.

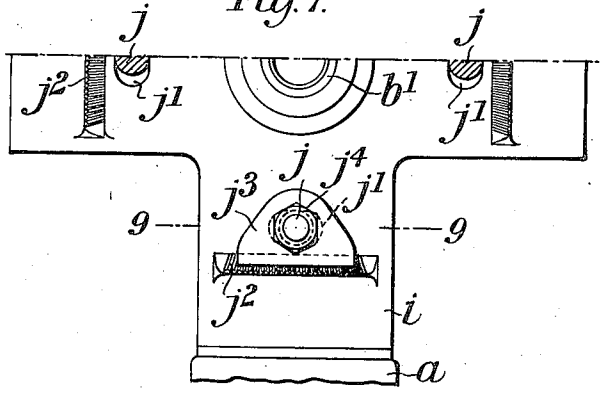


Fig. 8.

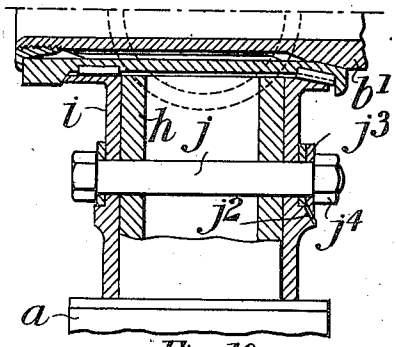


Fig. 9.

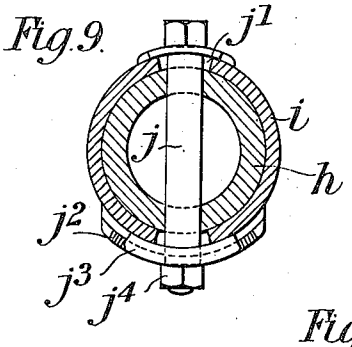


Fig. 10.

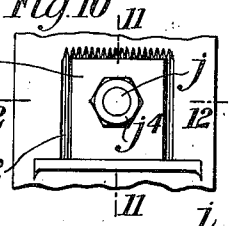


Fig. 11.

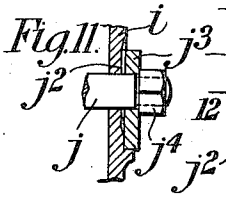


Fig. 12.

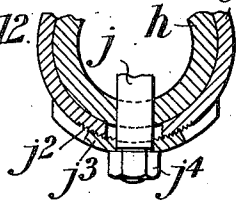
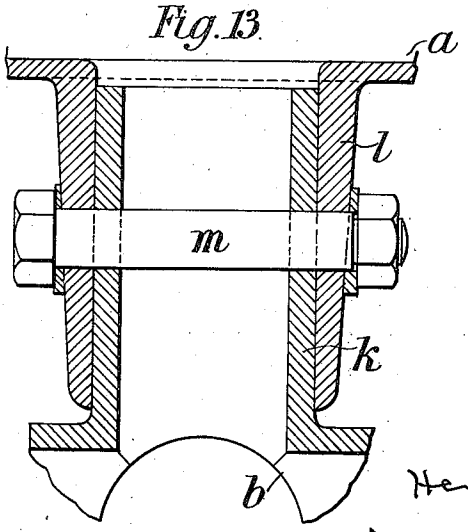


Fig. 13.



Inventor

Henry Leitner

By

George A. Pominski

Atty.

H. LEITNER.

SCREW PROPELLER.

APPLICATION FILED NOV. 4, 1920.

1,414,742. Patented May 2, 1922.

5 SHEETS—SHEET 3.

Fig. 14.

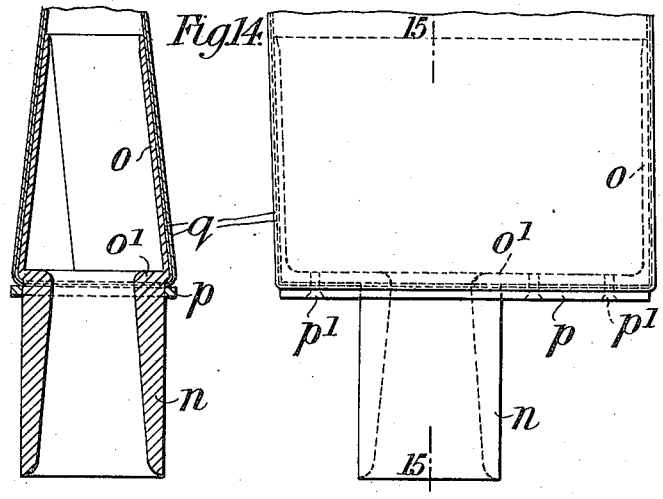


Fig. 15.

Fig. 16.

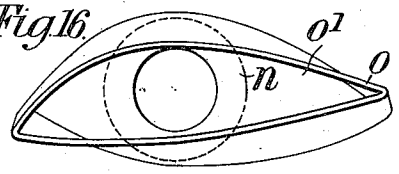


Fig. 17.

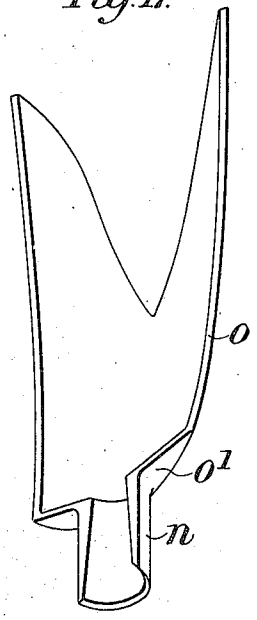
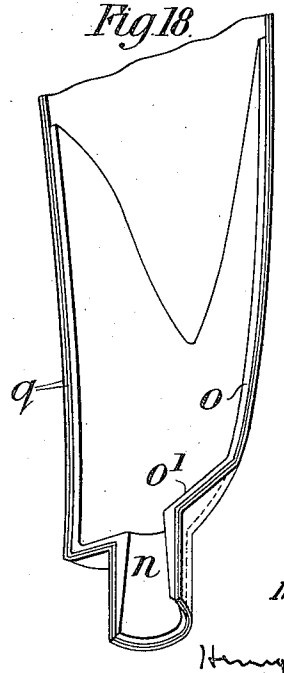


Fig. 18.



Inventor

Henry Leitner

By

George A. Pownall

Atty

H. LEITNER.

SCREW PROPELLER.

APPLICATION FILED NOV. 4, 1920.

1,414,742. Patented May 2, 1922.

5 SHEETS—SHEET 4.

Fig. 19.

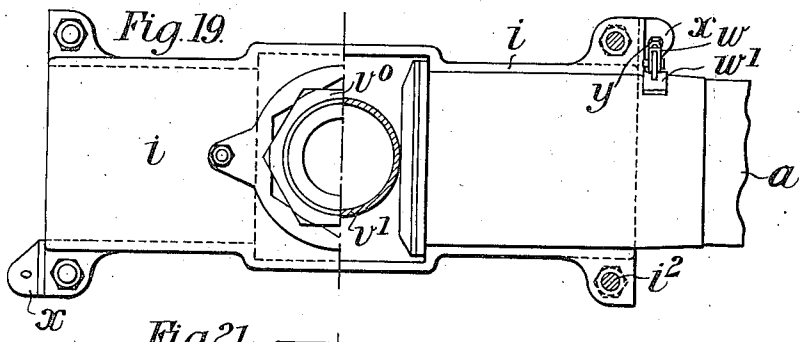


Fig. 21.

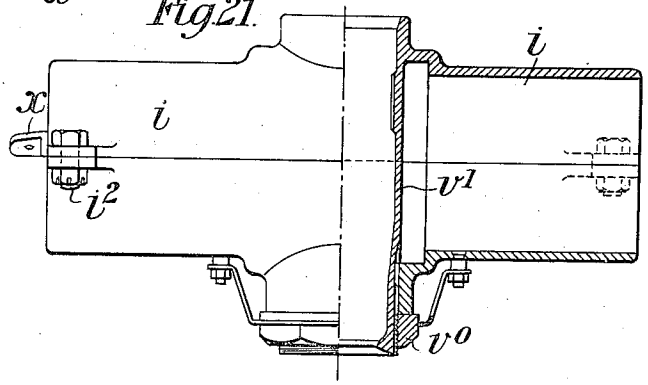


Fig. 20.

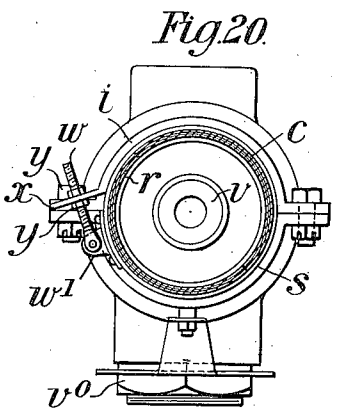


Fig. 24.

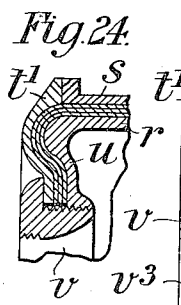


Fig. 22.

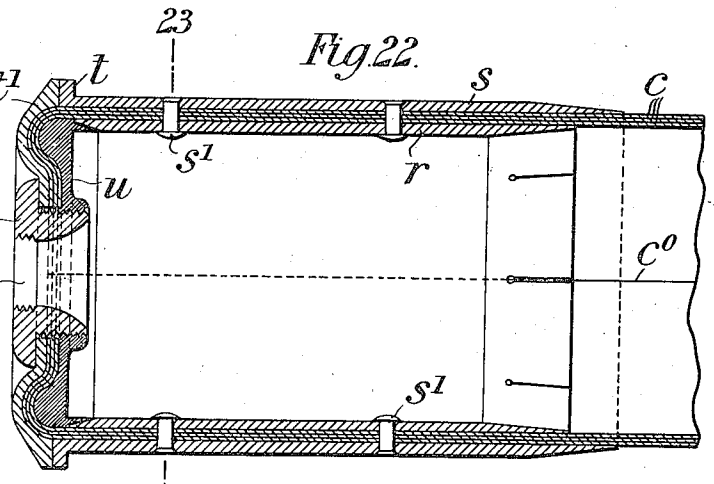
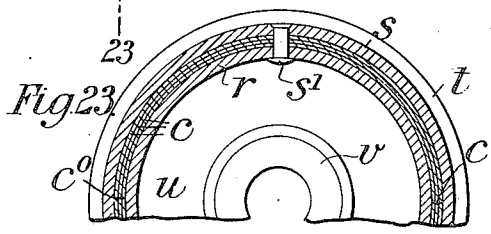


Fig. 23.



Inventor

Henry Leitner

By

George A. Barnard

Atty.

H. LEITNER.

SCREW PROPELLER.

APPLICATION FILED NOV. 4, 1920.

1,414,742.

Patented May 2, 1922.

5 SHEETS—SHEET 5.

Fig. 25.

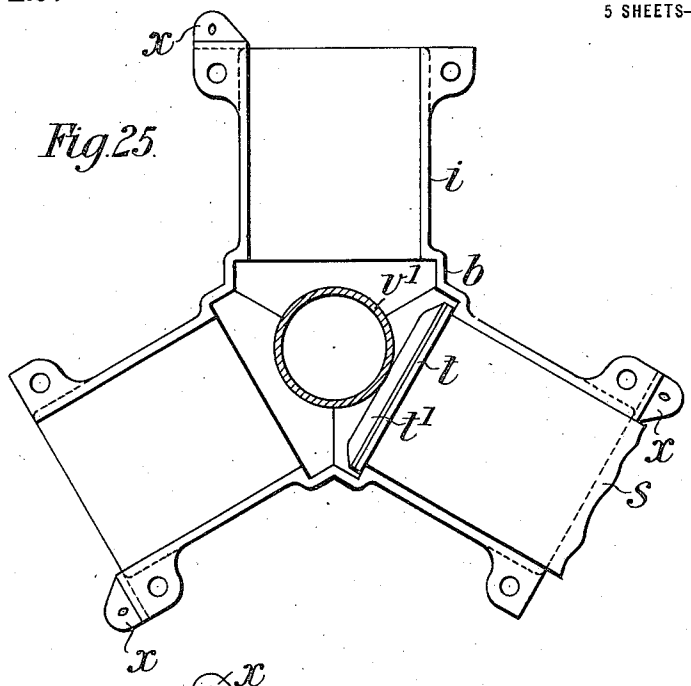
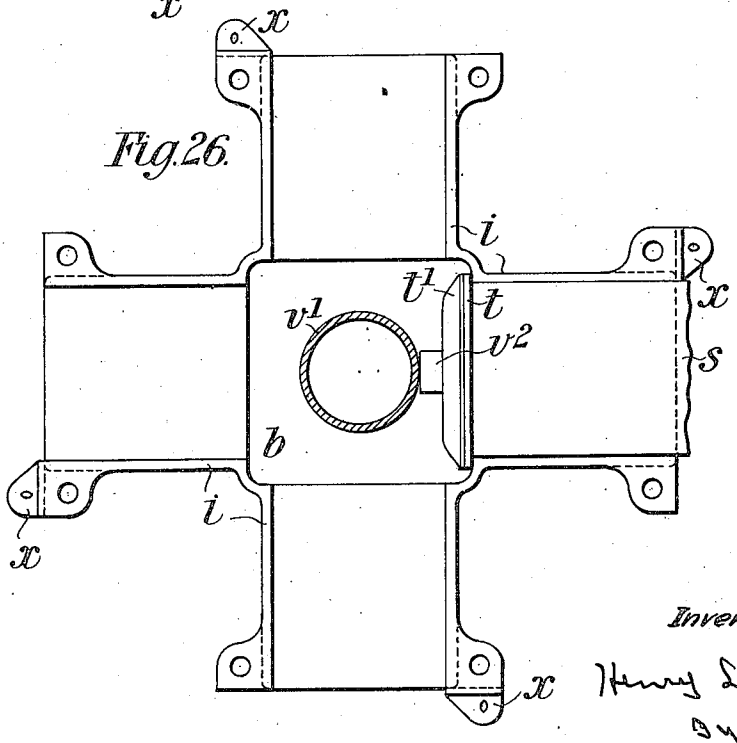


Fig. 26.



Inventor

Henry Leitner

By

George A. Parmenter

Atty.

UNITED STATES PATENT OFFICE.

HENRY LEITNER, OF LONDON, ENGLAND.

SCREW PROPELLER.

1,414,742. Specification of Letters Patent. Patented May 2, 1922.

Application filed November 4, 1920. Serial No. 421,753.

To all whom it may concern:

Be it known that I, HENRY LEITNER, a subject of the King of Great Britain, residing at Regent House, Kingsway, London, England, have invented new and useful Improvements in Screw Propellers, of which the following is a specification.

This invention relates to screw-propellers of the kind in which laminated blades are formed as independent units, each of which is attached to the hub, and the invention comprises improvements in the construction of the blades whereby the centrifugal stresses to which the blades are subjected are transmitted by the laminations directly to the hub, improved means for effecting the adjustability of the pitch of the propeller and also improved means for attaching the blades to the hub.

According to the invention the blades are constructed with one or more of the laminæ integral with the stems thereof.

In one arrangement for carrying the invention into practice each blade is advantageously constructed as described in the specification of my Patent No. 151693, that is to say, is composed of lamina or laminæ which is, or are, extended with or without a joint round the base portion of a pair of triangular driving plates which form the root of the blade, and which have extensions forming inner laminæ for the blade. The stem or stalk of the blade is formed integral with the said plates and extension laminæ. The said stem or stalk may be adjustably secured within the socket provided on the hub to receive it, say, by means of a transverse bolt which extends through the socket and the stem or stalk, the holes in the socket or stalk being elongated so that a certain angular movement is permitted to the said bolt, whereby the said stem or stalk can be turned within the socket. To clamp the said stem or stalk in the position to which it may be adjusted I may make use of a series of serrations or teeth upon the outer surface of the hub socket which engage with serrations or teeth upon a bearing plate or washer through which the bolt passes. As will be understood, by loosening the nut which tightens the bolt the serrations on the plate or washer may be freed from those on the hub socket, and the bolt, together with the stem or stalk, turned to the desired extent, after which the tightening of the nut will clamp the parts in the new position.

In some cases the clamping plate previously referred to may be furnished with teeth or serrations designed to engage with teeth or serrations upon the hub, the adjustment and locking of the blade stem or stalk being effected through the medium of these mutually engaging teeth.

The hub which may have two, three or more sockets may be made in one piece or it may be made in halves, preferably as stampings, pressings, or forgings which are adapted to be secured together in any convenient manner, as, for example, by bolts. Each of the hub halves is formed with a number, corresponding to the number of blades with which it is to be fitted, of semi-cylindrical depressions, the depressions on one half of the hub, when the two halves are brought together, being in register with those of the other half, so as to provide a series of cylindrical sockets. In the case of the hub made in halves the stems or stalks may be held in position radially through the medium of annular or bulbous extensions upon the inner ends of the said stems or stalks which are clamped between the said halves of the hub in such a manner as to permit of the necessary turning movement for the adjustment of the pitch of the propeller.

In some cases, by providing a suitable inner end to the propeller blades or laminæ, the hub sockets may be made to enter these for fixation, the locking and adjusting being similar to those above referred to.

In another arrangement where the blade is furnished with one or more laminæ or linings in addition to the outer sheath constituting the blade proper I may dispense with the triangular driving plates and extension laminæ and make the inner lining or lamina integral with the stem to fit entirely around within the other laminæ, and the combined inner lamina and stalk may, in practice, be made in one piece or in halves.

In another arrangement all the laminations of each blade are continued to form the tubular stem or stalk. In the course of building up the blade, the tubular stem or stalk is built around and preferably attached to a sleeve or shell which forms an internal support giving rigidity to the said stem, and over the stem so formed there may be passed

a second sleeve or shell which is secured to it by suitable means. The laminated blade stem is thus securely held between the two cylindrical shells or sleeves and is sufficiently rigid to withstand the stresses to which it is subjected in use.

To enable the invention to be fully understood, I will describe it by reference to the accompanying drawings, in which:—

Figure 1 is an elevation, with a part broken away, of the hub of a four-bladed propeller with variable pitch blades according to the invention and showing a portion of one only of the said blades in position.

Figure 2 is a sectional elevation at right angles to Figure 1.

Figures 3 and 4 are views at right angles of a portion of one of the propeller blades detached and,

Figure 5 is an underside view thereof.

Figure 6 is a plan of a blank which serves to form a part of the root of the blade.

Figure 7 is an elevation of half of a propeller hub similar to that shown in Figure 1 but showing modified means for securing the blades to the hub after adjustment therein.

Figure 8 is a sectional elevation at right angles to Figure 7, and

Figure 9 is a section on the line 9—9, Figure 7.

Figure 10 is an elevation of a portion of one of the hub sockets for receiving the stem of a propeller blade showing another arrangement for securing the said blade after adjustment.

Figures 11 and 12 are sections, respectively, on the lines 11—11 and 12—12, Figure 10.

Figure 13 is a section illustrating the arrangement in which a blade stem fits outside a hub socket instead of within it.

Figure 14 is an elevation of the root and stem of a blade showing the inner lining of the root made integral with the said stem.

Figure 15 is a section on the line 15—15, Figure 14, and

Figure 16 is a plan of the said inner lining and stem.

Figure 17 is a perspective view illustrating an integral construction of the inner lining of the root and stem of a blade but formed in halves in the direction of the length of the blades, one half only being shown.

Figure 18 shows an integral inner lining and stem as in Figure 17, but with the laminations forming the remainder of the blade extended and fitting round the said stem.

Figure 19 is an elevation with a part removed of the hub of a two bladed propeller with a portion of the blade in position, illustrating a modification in the construction of the blade stem and in the means for varying the pitch of the blade.

Figure 20 is an end view and

Figure 21 is a sectional plan thereof.

Figure 22 is an enlarged sectional view of the blade stem.

Figure 23 is a section on the line 22—23, Figure 22.

Figure 24 is a section illustrating a modification of the construction shown in Figure 22.

Figure 25 is a sectional elevation of one half of the hub of a three-bladed propeller provided with blades of the type described with reference to Figures 19 to 22, one of the blades being shown in position and

Figure 26 is a similar view to Figure 23 of the hub of a four-bladed propeller.

a indicates the propeller blades, b the hub carrying the said blades and b^1 the propeller shaft.

In the arrangement illustrated in Figures 1 to 6, the blades a are advantageously constructed as described in the specification of my Patent No. 151693 as shown clearly in Figures 3, 4 and 5, that is to say, each blade is composed of metal laminæ c extended with or without a joint around the base portion d of, or extending between, a pair of triangular plates e at the root of the blade. The blank from which the base-piece and triangular plates are formed is shown in Figure 6, two rectangular extensions or laminæ f being also formed on the base piece d to which the laminæ c are attached, for instance, by screws f^1. These triangular and rectangular extensions are bent along the dot and dash lines g, Figure 6, into the position indicated in Figures 3 and 4, the butting edges of the laminæ c and triangular plates e being welded together as also are the edges of the said laminæ c themselves where they butt together after leaving the said plates e.

h is the stem or stalk of each propeller blade, which stem is cylindrical and formed integral with the base d, and consequently with the laminæ f, the laminæ c being secured to the said base-piece d by a clamping plate h^1 and screws h^2.

The hub is, as shown in Figures 1 and 2, formed in halves, each half being, as above described, a metal stamping provided with semi-cylindrical depressions i, designed, when the halves are secured together, in a plane i^1 at right angles to the axis of the propeller shaft b^1, by means of the bolts i^2, to form the blade sockets into which the stalks or stems h are fitted. To prevent radial movement of the said stems in the sockets, the former are provided with bulbous or annular ends h^3 designed to engage corresponding recesses i^3 in the sockets.

The hub is secured to the propeller-shaft by keys or serrations and by frictional engagement, for which purpose a taper sleeve b^2 is keyed or fitted transversely across the hub in which it is secured by the shoulders

b^3 at one end and the nut b^4 at the other end. The taper end of the shaft b^1 enters the taper sleeve b^2 and is tightened therein frictionally by means of the nut b^5 which engages its projecting screw-threaded end b^6 and is fitted in the recessed end b^7 of the sleeve b^2, keyways also being formed in the sleeve and shaft to receive keys b^8.

To secure the blades a against turning movement within the sockets i, except when adjusting for pitch, I form each of the clamping plates h^1 with one edge curved to a circle concentric with the centre of the connected stem and this edge I provide with serrations or teeth h^4. These serrations h^4 on each blade engage with a corresponding set of serrations i^4 on an extension or lug on the socket carrying the blade, so that the blade is locked against any turning movement within the socket when the two parts of the hub are secured together. When, however, it is required to alter the pitch of the blades, the two parts of the hub must be separated sufficiently to allow of lifting the blades to release them from the serrations i^3, and turning them to the required extent when they are again moved into engagement with the said serrations and the parts of the hub again secured together.

Figures 7, 8 and 9 illustrate an arrangement wherein the bulbous or flanged end of the stem h is dispensed with and radial movement of the said stem is prevented by a transverse bolt j passing through the stem and hub socket i. To allow of adjusting the pitch of the blades the holes j^1 in the sockets i through which the said bolts pass are slightly elongated, as indicated in Figures 7 and 9, to allow the said bolts to turn with the stems h, and to permit of clamping the bolts, after such adjustment, serrations j^2 are formed on the sockets i with which engage corresponding serrations on bearing plates or washers j^3 when nuts j^4 on the said bolts are tightened up. In the arrangement just described, the serrations are at an angle to the axis of each socket i but in the arrangement shown in Figures 10 to 12 the serrations are parallel to the said axis. It will of course be seen that in the last described arrangements, the stems h of the blades can be introduced into the sockets i radially, in which case the hub need not be made in halves connected together as previously described.

Instead of stems in the blades fitting within sockets on the hub as above described I may, as shown in Figure 13, form stems k on the hub b fitting within tubular blade stalks l, transverse bolts m, similar to the bolts j, being provided for securing and locking the parts together. It will of course be understood that adjustment for pitch can in this arrangement also be provided for by the use of serrations on the socket in conjunction with a serrated washer, as in the arrangements illustrated in Figures 7 to 12.

Figures 14 to 16 illustrate the construction wherein the stem or stalk of a blade having one or more laminæ in addition to the outer sheath constituting the blade proper, is made integral with the inner lamina. n indicates the stem or stalk and o the inner lamina with which it is integral, a plate p being employed to clamp and secure by screws p^1 the portions of the outer laminæ q which are turned underneath the base piece o^1 of said inner lamina.

Figure 17 illustrates a construction of integral stem n and inner lamina o similar to that shown in Figures 14 to 16 except that the said integral stem and lamina are formed in halves, one half only being illustrated. The said halves correspond with and fit within the outer laminæ of the blade which is also formed in halves, the edges of which and also the edges of the lamina o and stem n being connected by welding or the like. In this arrangement the said outer laminæ are also attached to the said inner lamina o similarly to the arrangement shown in the said Figures 14 to 16 in addition to the welding together, but in Figure 18 is shewn a construction wherein the outer laminæ are extended down and fitted around the stem, the whole being welded together along their common butt joint.

In the arrangement illustrated in Figures 19 to 23 in which the laminæ c gradually change from the aerofoil section to that of the cylindrical stem, r is the inner sleeve or shell around which the said laminæ are built to form the stem, the butting edges of which laminæ are connected together and also to the said sleeve at c^0 by welding or the like. s is the second sleeve or shell passed over the stem, the whole being connected together by rivets s^1. This shell s is bulbous or flanged as at t to prevent radial movement of the blade in one direction in the hub socket and has integral therewith or connected thereto by welding or the like a disc t^1 between which and another disc u which forms a closed end to the sleeve r are arranged the turned-in ends of the laminæ, the whole being clamped together by the screwed plug v. Instead of the disc u being separated from the sleeve r it may be integral therewith as shown in Figure 24. In some cases the sleeve s may be dispensed with, the edge of the disc t serving to prevent radial movement of the blade in one direction. The radial movement of the propeller blade in the other direction is prevented by a sleeve v^1, Figures 19, 21 and 23, for the propeller shaft, and which sleeve is formed integral with one half of the hub and secured to the other half by

a nut v^0. Or the sleeve may be separate from the hub and secured thereto in any suitable way.

In the hub shown in Figure 26 where greater room is required at the centre of the hub owing to the greater number of blades, distance pieces v^2 are arranged between the blade stems and the said sleeve v^1, the said distance pieces screwing into holes v^3 in the plugs v.

For adjusting the blades in the hub sockets in order to alter the pitch thereof, bolts w are pivoted to lugs w^1 on the blades and pass through holes in lugs x on the hub sockets and are secured thereto by nuts y as clearly shown in Figures 19 and 20. The blades are also held against turning movement in the hub sockets by friction therewith. To enable adjustment of the blades to be effected, the bolts i^2 and the nuts v^0 must be slackened to unclamp the sockets from the stems when the latter can be turned.

As will be understood, the sides of the stem or stalks may be parallel as already shown, or they may be tapered in either direction. Furthermore, it will be understood that, although I prefer to use the laminated stem or stalk as above described, yet I may, in lieu thereof, use a stem formed from taper gauge metal, such a stem being employed either with or without the shells or sleeves above described.

Propellers constructed in accordance with the invention are suitable for use with aircraft of any type, including the ordinary heavier than air machines, helicopter machines, or machines of the lighter than air type.

Claims:

1. A screw propeller comprising blades built up of metal laminæ and provided with stems, a hub provided with sockets to receive said stems, means for adjusting said stems in said sockets for varying the pitch, said blade stems being made integral with one or more of said laminæ.

2. A screw propeller as claimed in claim 1, the stem of each blade being integral with the innermost lamina of said blade, said lamina comprising a base piece adapted to carry the stem and triangular and rectangular extensions for the attachment of the remaining laminæ, which are carried beneath said base piece, said remaining laminæ being secured to said base piece by means of a clamping plate.

3. A screw-propeller as claimed in claim 1, wherein the integral inner lamina and stem are made in halves, substantially as described.

4. A screw propeller as claimed in claim 1, in which each blade is provided with teeth adapted to engage corresponding teeth in connection with the hub for securing the blade in any desired position after adjustment for pitch.

5. A screw propeller as claimed in claim 1, the stem of each blade being integral with the innermost lamina of said blade, said lamina comprising a base piece adapted to carry the stem and triangular and rectangular extensions for the attachment of the remaining laminæ, which are carried beneath said base piece, said remaining laminæ being secured to said base piece by means of a clamping plate, said clamping plate being provided with teeth which engage similar teeth formed on the hub to secure the blade in any required position.

6. A screw propeller as claimed in claim 1, wherein the blade stems are provided with transverse bolts, said bolts being adapted to be passed through the stems and the hub sockets, to prevent the radial movement of the blades.

7. A screw propeller as claimed in claim 1, wherein the blade stems are provided with transverse bolts adapted to be passed through the stems and the hub sockets, to prevent radial movement of the blades, said bolts being provided with toothed washers, adapted to engage similar teeth in the hub sockets for securing the blades after adjustment.

8. A hub for a screw propeller, composed of two parts each having semi-cylindrical depressions which form sockets for the blade stems of said propeller when the two parts are clamped together, said clamping holding the blades in position in the hub frictionally, a propeller shaft being connected to said hub by a sleeve, formed integral with one part of the hub.

9. A screw-propeller as claimed in claim 1, wherein the inner ends of the stems of the blades are formed or provided with annular or bulbous extensions to prevent radial movement of the said blades relatively to the hub, substantially as described.

10. In a screw-propeller as claimed in claim 1, the combination with that portion of the laminæ of each blade which forms the stem, of an inner sleeve or shell secured to the laminæ, substantially as described.

11. A screw propeller comprising blades built up of laminæ, the stems of said blades being provided with an inner sleeve and an outer sleeve, said outer sleeve having an annular extension, said two sleeves being secured to the laminæ.

12. A screw propeller, comprising blades built up of laminæ, the stems of said blades being provided with an inner sleeve and an outer sleeve, said sleeves having extensions which are bent at right angles to the axis of the blade stems and secured between clamping surfaces, one of which is adapted to engage with the hub.

HENRY LEITNER.