Aug. 25, 1942. R. M. SCHAEFER 2,293,768

BLADE

Filed Jan. 4, 1941

Fig. 1.

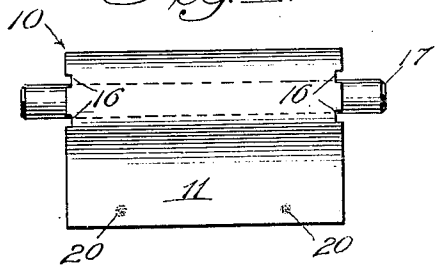


Fig. 2.

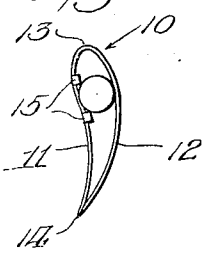


Fig. 5.

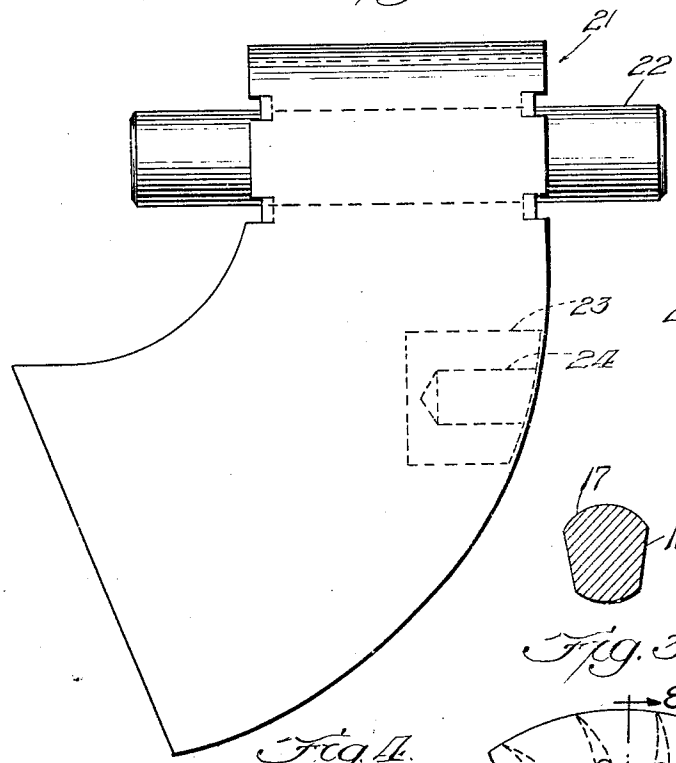


Fig. 6.

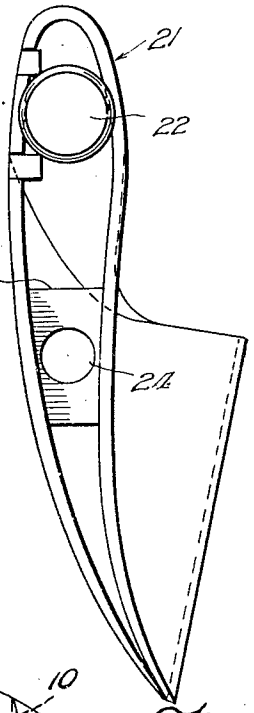
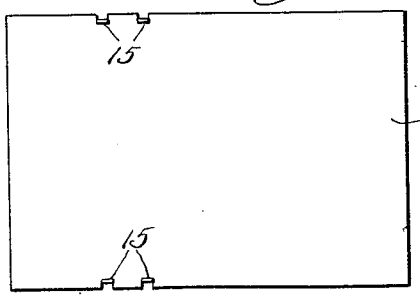


Fig. 3.

Fig. 4.



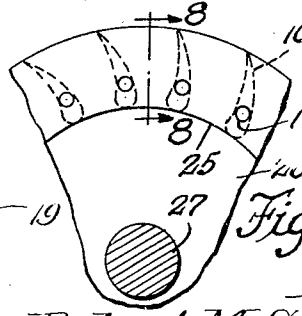
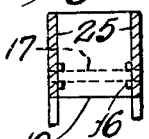


Fig. 7.

Fig. 8



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Attys.

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2,293,768

UNITED STATES PATENT OFFICE

2,293,768

BLADE

Robert M. Schaefer, Racine, Wis., assignor to Twin Disc Clutch Company, Racine, Wis., a corporation of Wisconsin

Application January 4, 1941, Serial No. 373,065

12 Claims. (Cl. 103—115)

My invention relates to blades for hydraulic power transmission units such as hydraulic couplings, hydraulic torque converters, and similar units wherein energy is transmitted by and to blades through a hydraulic medium.

By way of example, my invention will be described in connection with blades for torque converters. Heretofore, it has been common practice to make these blades from drawn brass stock, which is cut in lengths equal to the length of the finished blades plus the supporting trunnions, the latter being turned to the proper diameter. The transverse sectional profile of these blades varies from comparatively simple shapes to those having complex curvatures which are designed for maximum efficiency. The manufacture of the latter in particular requires special machine equipment, which means high unit cost, and the problem becomes more complicated and more expensive with blades of larger size. Moreover, in blades of this character, there is a weight problem involved due to the solid nature of the part and the latter aspect is further reflected in high material cost due to the character of the metal.

It is, therefore, the principal object of my invention to provide a blade which is bent into shape from a stamping and in which the trunnion pin or pins serve to strengthen the blade section.

A further object is to devise a blade which is hollow and, therefore, considerably lighter than solid blades, and in which provision is made for deaerating the blade interior during operation to prevent unbalancing of the rotor to which the blade is connected.

A further object is to provide a blade of the character indicated which can be made from relatively inexpensive materials, such as sheet steel for the blade proper and cold rolled steel stock for the trunnion.

These and further objects of my invention will be set forth in the following specification, reference being had to the accompanying drawing, and the novel means by which said objects are effectuated will be definitely pointed out in the claims.

In the drawing:

Figure 1 is an elevation of my improved blade.

Fig. 2 is an end view of the blade shown in Fig. 1.

Fig. 3 is a transverse section of that portion of the trunnion pin which is included between the ends of the blade.

Fig. 4 is a plan view of the stamping from which the blade is formed.

Figs. 5 and 6 are elevation and end views, respectively, of a modified form of blade.

Fig. 7 is a fragmentary elevation of a rotor, partly in section, showing my improved blades attached thereto.

Fig. 8 is a section along the line 8—8 in Fig. 7.

Referring to Figs. 1 to 4, inclusive, the numeral 10 designates my improved blade which is generally in the form of an open-ended shell comprising a pair of opposed, impervious walls 11 and 12, which in the particular shape of blade shown are, respectively, concave and convex. Along one side of the blade, these walls are connected by a curved end wall 13 which constitutes the inlet edge of the blade and at the opposite edges the walls are brought together to form the relatively sharp tip 14. Considering the other edges as the ends of the blade, one of the walls, for example the wall 11, is provided with a pair of spaced tongues 15 at each end edge, these tongues being formed by slitting the wall 11 inwardly from the end edges and thereafter bending the tongues inwardly of the blade so as to lie generally normal to the plane of the wall. The bending of these tongues creates deaerating notches 16 for a purpose hereinafter explained, and the tongues are employed to initially locate a trunnion pin 17 which extends completely through the blade in bearing and secured relation to the walls 11 and 12 and has its opposite ends projecting beyond the ends of the blade for suitable mounting in a carrier. If the dimensions of the blade or the operating conditions require, a second trunnion pin may also be employed and this pin would be spaced from the pin 17. In order to provide maximum strength in the trunnion pin for any given section of blade, I preferably flatten the bearing sides of the pin, as indicated by the numeral 18 in Fig. 3, along that part which is included between the ends of the blade, or the indicated intermediate portion of the pin may possess an appropriate elliptical cross section or be otherwise deformed. The bearing surfaces of the trunnion pin are shaped and angularly related to conform to the opposed blade walls along the areas of contact. This expedient provides the maximum diameter for the projecting ends of the pin and at the same time facilitates the insertion of the pin between the walls 11 and 12 as hereinafter described.

The body of the blade 10 is preferably made from a flat steel stamping 19 which, in the case of the blade illustrated in Fig. 1, possesses a rectangular shape and may be made from oiled sheet steel of appropriate gauge, dependent upon the

section of the blade and the forces to which it is subjected. The stamping 19 is slit along its longitudinal edges to provide the tongues 15 which are then bent normal to the stamping, after which the stamping is reversely bent intermediate its ends and shaped to the desired profile. In this connection, it will be understood that my invention is not restricted to a blade having the profile illustrated in Fig. 2, as the more generic aspects of the invention are directed to an inexpensive and light-weight blade, in which the trunnion pin serves to strengthen the blade section by passing completely through the blade. After the stamping has been bent, its adjacent end edges are flattened cold, or "coined," in order to insure that, when the indicated ends are secured together, the abutting portions of the stamping will be sufficiently reduced in thickness to provide the required shape at the tip of the blade.

The trunnion pin 17 is then inserted between the walls 11 and 12 and positioned endwise so that its ends project the same distance beyond the ends of the blades and also so that the pin is positioned between each pair of tongues 15. The adjacent ends of the reversely bent stamping 19 are then temporarily secured to each other by means of one or more spot welds, generally indicated by the numeral 20 in Fig. 1, and the complete assembly is then passed through a hydrogen furnace where the pin 17 is brazed to the walls 11 and 12 and the ends of the stamping 19 are brazed to each other to form the tip 14.

The foregoing arrangement of parts may be employed with any desired blade profile and for impeller or pump blades, turbine or runner blades, and fixed or reaction blades and for any type of power unit in which power is transmitted by means of the impingement of a fluid medium on a blade. In the case of the impeller and turbine blades, it is necessary to provide some means for insuring a complete deaeration of the interior of the blades, otherwise the rotor to which the blades are secured may be unbalanced during rotation. This result is achieved by the use of the deaerating notches 16. In this connection, it will be understood that while blades of this character are more or less snugly fitted between the opposite walls of the carrier, dimensional discrepancies may result in small openings between edges of some of the blades and the walls of the carrier and the absence of such openings in other similar locations around the unit. Under these conditions, it will be obvious that, unless deaerating openings were provided, the more snugly fitted blades would retain any air that may have collected therein when the hydraulic power unit is out of service, and this mass of air would not be evacuated when the unit began operation. The provision of the notches 16 completely obviates any operating difficulty in this respect. The invention is not restricted to placing the notches 16 along the edges of the blades, for it is contemplated that these openings, as well as the tongues 13, may be otherwise located, including intermediate positions in the blade surface. In Figs. 7 and 8 are illustrated a characteristic mounting of the blades 10 between the spaced, impervious walls 25 of the rotor 26 which is secured to a shaft 27.

In Figs. 5 and 6, there is illustrated a modified construction that embodies the advantages of the blade heretofore described and, in addition, incorporates a feature that is particularly useful in connection with blades having a greater length than that illustrated in Fig. 1, the length being measured in the direction of the fluid flow across the blade. In this modification, the numeral 21 designates the blade generally, which includes a trunnion pin 22 that is mounted and secured to the blade in the manner above described, and which also includes, in offset relation to the pin 22, an insert block 23 that is secured between the opposed walls of the blade, and which is provided with a socket 24 for receiving a dowel pin whose opposite end is mounted in its carrier, either fixed or moving. With this construction, it is possible to materially lessen the twisting action on the trunnion pin 22, set up by the reaction of the working fluid.

In some constructions, such as in certain stages of torque converters and in hydraulic couplings which are not provided with shroud rings, the trunnion pin need only extend beyond one open end of the blade for mounting in a rotor. The blade is then carried by a cantilever support.

I claim:

1. A blade comprising a hollow shell whose opposite walls are shaped to the desired profile, and a cylindrical trunnion pin extending between the walls and beyond an end of the shell for mounting in a carrier, the pin being secured to and bearing on the shell and being slightly flattened along the bearing surfaces to secure maximum diameter of the projecting end of the trunnion.

2. A blade for hydraulic power units comprising a pair of opposed, impervious walls connected along a pair of their opposite edges, respectively, and otherwise spaced from each other, and one or more deaerating notches provided in an edge of one of the walls communicating with the interior of the blade.

3. A blade for hydraulic power units comprising a pair of opposed, impervious walls connected along a pair of their opposite edges, respectively, and otherwise spaced from each other, a pair of spaced tongues bent out of the body of one of the walls along each edge other than the connected edges, the bending forming a pair of deaerating notches communicating with the interior of the blade, and a trunnion pin extending across the blade between each pair of tongues and disposed between and secured to the walls, the tongues serving to position the pin while being secured to the blade.

4. A blade comprising a hollow shell whose opposite walls are shaped to the desired profile, a trunnion pin extending between the walls and beyond at least one end of the shell for mounting in a carrier, the pin being secured to the walls, and an insert block located within the shell and secured to the walls for receiving a pin mounted in the carrier wall whereby twisting effort on the trunnion pin is reduced.

5. A blade comprising a pair of opposed walls connected along a pair of their opposite edges, respectively, and otherwise spaced from each other, and a trunnion pin extending between the walls and beyond at least one end of the shell for mounting in a carrier, the pin bearing on and being secured to the opposite walls and spaced from said opposite edges to thereby strengthen the shell against fluid pressure.

6. A blade comprising a flat stamping reversely bent intermediate its ends, the ends being secured together and the opposite walls being otherwise separated, and a trunnion pin extending between and secured to the walls in spaced relation to the

reversely bent portion to thereby strengthen the shell against fluid pressure.

7. A blade comprising a pair of opposed walls connected along a pair of their opposite edges, respectively, and otherwise spaced from each other, tongues extending interiorly of the blade and a trunnion pin extending across the blade between the tongues and secured to at least one wall, the tongues serving to position the pin while being secured to the blade.

8. In a power unit for hydraulically transmitting power, the combination of a rotor having a pair of spaced, annular, impervious walls and a plurality of circumferentially spaced blades fitting snugly between the walls to define a plurality of passages through which fluid passes when the rotor is rotated, each blade comprising a hollow shell having deaerating apertures adjacent the ends thereof communicating with the interior of the shell, the air in the shell being discharged through the apertures during the early stages of rotation of the rotor and replaced by the fluid to prevent unbalancing of the rotor.

9. In a power unit for hydraulically transmitting power, the combination of a rotor having a pair of spaced, annular, impervious walls and a plurality of circumferentially spaced blades fitting snugly between the walls to define a plurality of passages through which fluid passes when the rotor is rotated, each blade comprising an open ended, hollow shell whose ends abut the walls and including one or more deaerating notches in an edge of the shell wall communicating with the interior of the shell, the air in the shell being discharged through the notches when the rotor is first rotated and replaced by fluid to prevent unbalancing of the rotor.

10. In a power unit for hydraulically transmitting power, the combination of a rotor having a pair of spaced, annular, impervious walls and a plurality of circumferentially spaced blades fitting snugly between the walls to define a plurality of passages through which fluid passes when the rotor is rotated, each blade comprising a hollow shell having a deaerating aperture in a wall thereof communicating with the interior of the shell, the air in the shell being discharged through the aperture when the rotor is first rotated and replaced by fluid to prevent unbalancing of the rotor.

11. A blade for a hydraulic power transmission unit comprising a flat stamping reversely bent intermediate its ends, the ends being secured together and the opposite walls being otherwise separated and including one or more deaerating notches in an edge of one of the walls other than the secured ends to provide a means of communication with the interior of the blade.

12. A blade for a hydraulic power transmission unit comprising a flat stamping reversely bent intermediate its ends, the ends being secured together and the opposite walls being otherwise spaced from each other, a pair of spaced tongues bent out of the body of one of the walls along each edge other than the connected ends, the bending forming a pair of deaerating notches providing a means of communication with the interior of the blade, and a trunnion pin extending across the blade between each pair of tongues and disposed between and secured to the walls, the tongues serving to position the pin while being secured to the blade.

ROBERT M. SCHAEFER.

DISCLAIMER

2,293,768.—*Robert M. Schaefer*, Racine, Wis. BLADE. Patent dated August 25, 1942. Disclaimer filed June 4, 1943, by the assignee, *Twin Disc Clutch Company*.

Hereby enters this disclaimer to claims 5 and 6 of said patent.

[*Official Gazette June 29, 1943.*]