Nov. 5, 1940. A. MEYER 2,220,420

MEANS FOR COOLING MACHINE PARTS

Filed Feb. 9, 1939 2 Sheets-Sheet 1

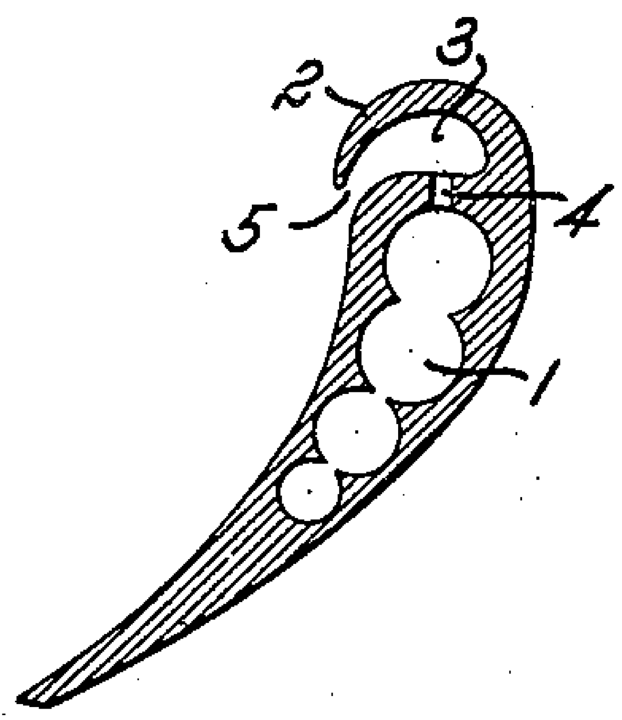

Fig. 1.

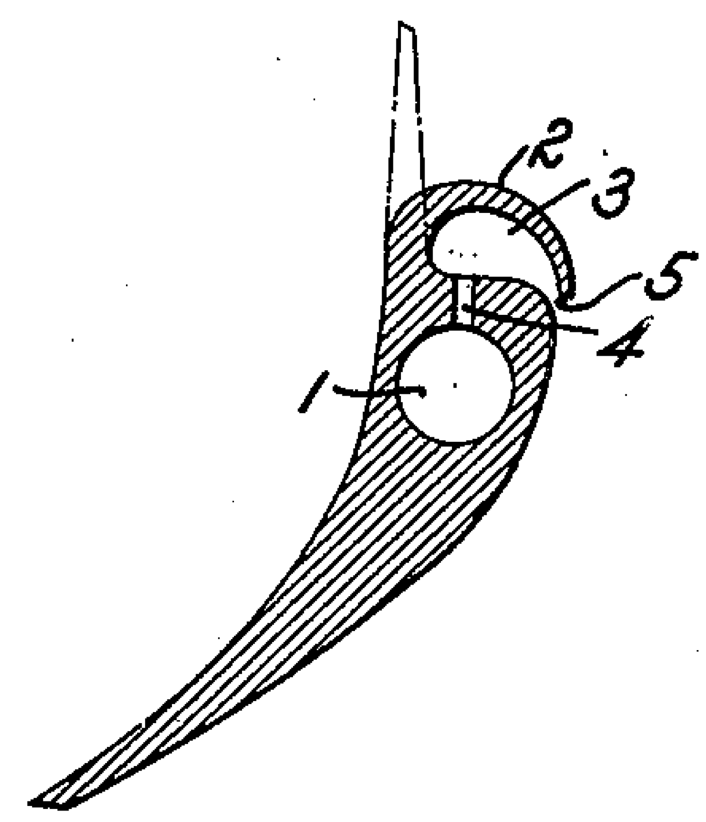

Fig. 2.

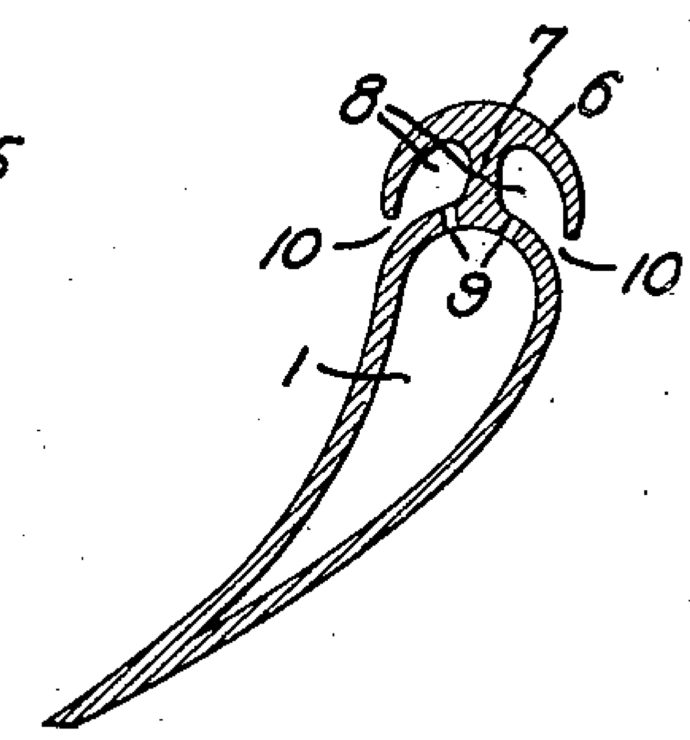

Fig. 3.

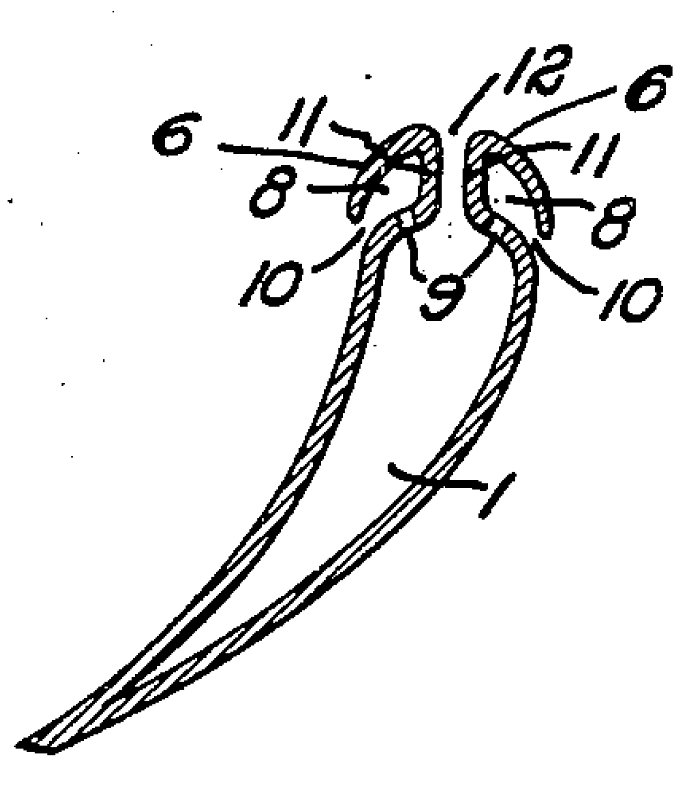

Fig. 4.

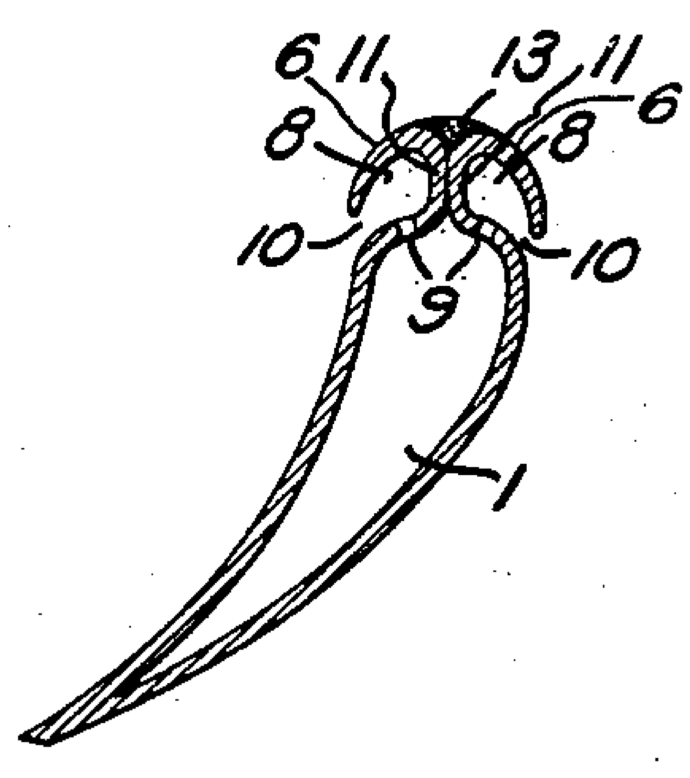

Fig. 5.

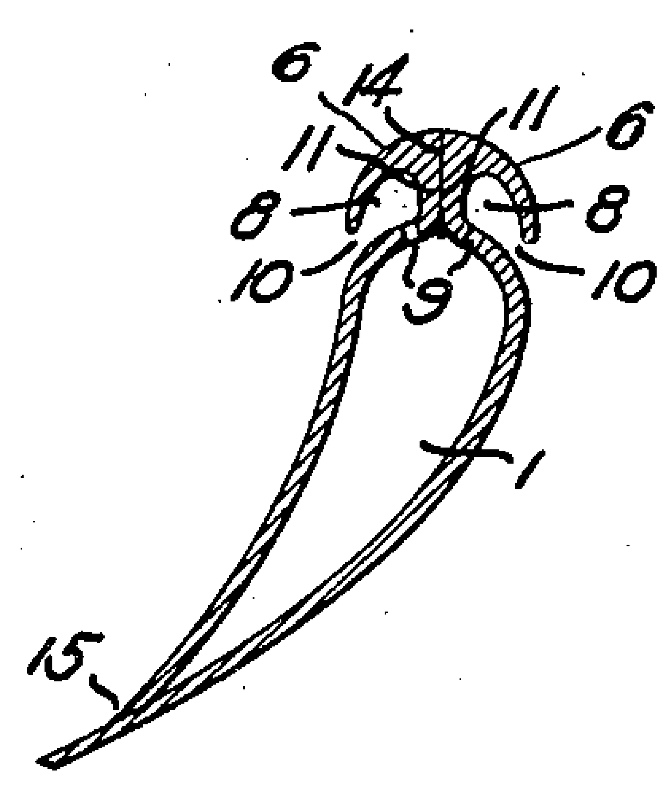

Fig. 6.

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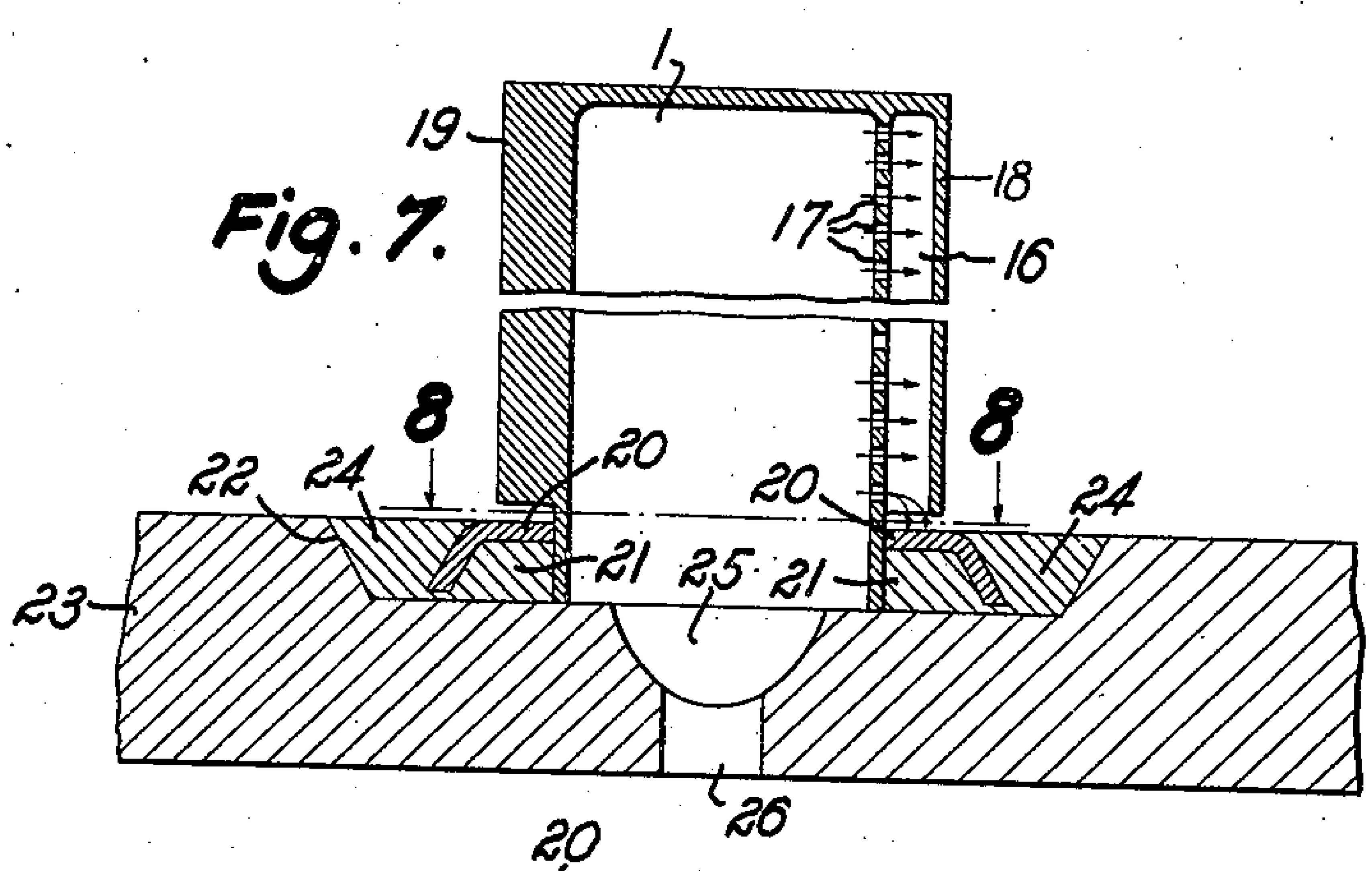
Fig. 7.



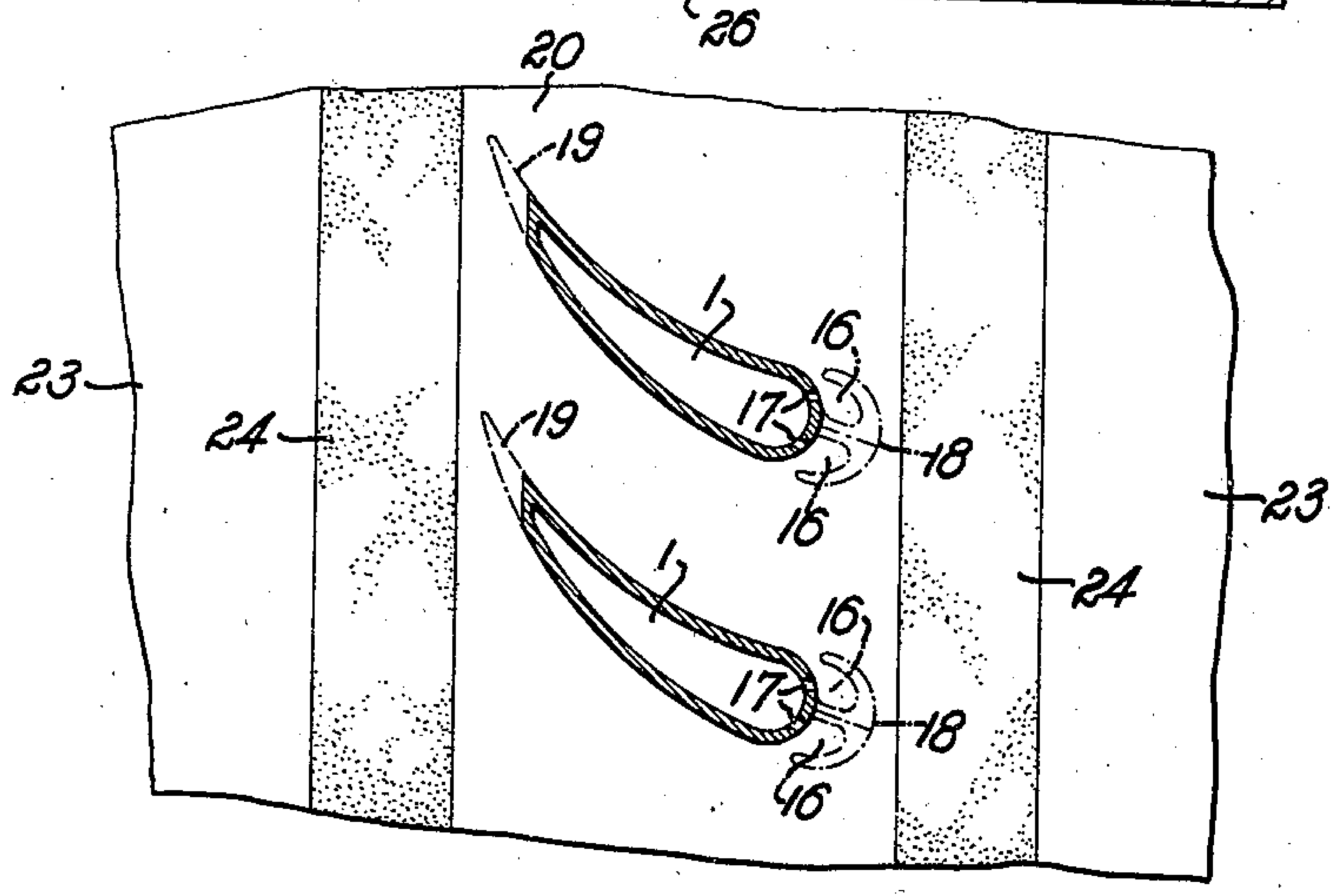


Fig. 8.

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UNITED STATES PATENT OFFICE

2,220,420

MEANS FOR COOLING MACHINE PARTS

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Application February 9, 1939, Serial No. 255,536
In Germany February 8, 1938

2 Claims. (Cl. 60—41)

It has been proposed to cool turbine blades or vanes by bathing the surfaces thereof with a cooling fluid. It has further been proposed to accomplish the distribution of the cooling fluid over the vane surfaces by delivering it through a passage in the blade from which it is discharged onto a surface of the blade through a slot or orifice. Experience has shown, however, that it is very difficult to secure an effective distribution of the cooling fluid in this way. The end of the blade particularly which needs cooling the most generally receives an insufficient supply of the cooling fluid due to the fall in pressure of the cooling fluid along the supply passage.

An object of the present invention is to provide a design of machine elements such as turbine blades which will assure an effective cooling thereof. According to the present invention the desired distribution of the cooling fluid, e. g., air, is obtained by the provision of two types of passages one of which feeds the cooling fluid through the machine element and is connected to the distribution passage which serves to distribute the cooling fluid over the desired portion of the element through suitable holes or slots the dimensions and distribution of which determine the distribution of the fluid.

The above statement of the invention will be more readily understood by reference to the accompanying drawings in which

Fig. 1 is a cross section through a turbine blade designed to supply cooling fluid to the concave side of the blade.

Fig. 2 is a cross section of a turbine blade designed to distribute cooling fluid to the convex surface of the blade.

Fig. 3 is a cross section of a turbine blade designed to distribute cooling fluid to both the concave and the convex surfaces of the blade.

Figs. 4, 5 and 6 are cross sections of modified constructions of blades similar to that illustrated in Fig. 3.

Fig. 7 is a longitudinal section through a turbine blade and its mounting and

Fig. 8 is a horizontal section on the line 8—8 of Fig. 7.

Referring to Fig. 1 the blade is formed of an integral mass of metal and the feed passage 1 for cooling fluid is formed by drilling a plurality of communicating holes of appropriate size depending on the thickness of the blade. The end of the blade consists of a fin 2 starting at the edge of the convex side of the blade and bent over in a half circle toward the edge of the concave side thereby forming the distribution passage 3 which is connected to the feed passage 1 by the orifices 4. The free edge of the curved over fin 2 is spaced a short distance from the body of the blade leaving the slot 5 for the delivery of the cooling fluid to the concave surface of the blade.

Fig. 2 shows a similar blade formed of an integral body of metal and provided with a cooling fluid feed passage 1 formed by a single drill hole through the blade. The end of the blade is formed by the bent over fin 2 the base of which, however, starts from the concave side of the blade and the free edge of which is adjacent the convex side of the blade. The original position of the fin 2 is shown in dot and dash lines. Passage 3, orifice 4 and slot 5 are the same as in Fig. 1 excepting of course that slot 5 is located to discharge cooling fluid on the convex surface of the blade.

The blade illustrated in Fig. 3 is formed of sheet material so that the cooling fluid feed passage 1 occupies the entire inner space of the blade enclosed by the wall which is of substantially uniform thickness. The blade is designed to cool both the convex and the concave surfaces by the provision of the dome shaped hood 6 supported by the central fin 7. The hood 6 and fin 7 together with the body of the blade enclose the two distribution passages 8, 8 which communicate with the feed passage 1 through the orifices 9, 9. Slots 10, 10 discharge the cooling fluid onto the convex and concave surfaces of the blade.

The blade shown by Fig. 4 is similar in construction to that of Fig. 3 excepting that the central fin 7 of Fig. 3 is replaced by the two spaced fins 11, 11 which are integral with the side walls of the blade. This construction divides the hood 6 into two parts with the orifice 12 between them which serve to discharge cooling fluid over the outer surface of the divided hood. This cooling fluid not only effectively cools the incident edge of the blade at the line of impact of the hot impelling fluid but also aids the cooling of the side walls of the blade by the cooling fluid issuing through orifices 10, 10. It will be noted also that the blade of Fig. 4 is an extremely simple construction which may be made by simple bending of sheet metal.

The blade of Fig. 5 is similar to that of Fig. 4 excepting that the orifice 12 is closed by bringing the adjacent walls of the fins 11, 11 together and welding at 13.

In the construction illustrated in Fig. 6 which is functionally similar to that of Fig. 5, the two side walls of the blade are formed by welding together two properly shaped sheets of metal. The welds appear at 14 and 15.

Fig. 7 shows the mounting of one of the blades, the figure being a longitudinal section through the blade. 1 is the feed passage through the blade, 16 the distribution passage for the delivery of the cooling fluid corresponding to passage 3 of Figs. 1 and 2 or the passages 8, 8 of Figs. 3–6, 17, 17 are orifices connecting passages 1 and 16, 18 is the wall enclosing passage 16 and corresponding to member 2 of Figs. 1 and 2 or member 6 of Figs. 3–6. As shown in Fig. 7, at the open end of the blade the wall 18 and the opposite edge of the blade 19 are cut away leaving only the wall which encloses the passage 1. This simplifies the shape of the base of the blade which is to be secured to the stator or rotor. This end of the blade is inserted through an opening in the plate 20 and is secured thereto by the welding or soldering metal 21. The resulting structure is set into the groove or depression 22 in the rotor or stator 23 and secured therein by the welding or soldering metal 24. The passage 1 within the vane is supplied with cooling fluid through the groove 25 and the drill holes 26 in the wall of the rotor or stator. In place of drill holes 26 which communicate with a chamber through which cooling fluid is supplied any other suitable means for delivering cooling fluid to the groove 25 may be employed. The cooling fluid may be supplied under suitable pressure by a multistage fan or blower.

Fig. 8 which is a section on the line 8—8 of Fig. 7, looking downward, indicates the location of the cut away portions 18 and 19 of the blade in dot and dash lines.

I claim:

1. A turbine blade comprising a body portion having two side surfaces, a passage extending partly through said body portion, a rounded leading edge portion extending along one side of said body portion, parallel passages in said leading edge portion, a duct extending between said parallel passages from said first passage to the surface of said rounded leading edge portion, holes connecting said first passage with each of said parallel passages and orifices in the outer wall of each of said parallel passages directed toward the adjacent side surface of said blade.

2. A turbine blade comprising a body portion, a relatively sharp trailing edge portion and an opposite rounded leading edge portion, a passage in said body portion and a communicating passage in said rounded leading edge portion for conveying cooling gas, a part of said sharp trailing edge portion and a part of said rounded leading edge portion being cut away leaving only the wall of the passage in said body portion at one end thereof as a foot member for the mounting of the blade, an orifice in the wall of the passage in said rounded leading edge portion for delivering cooling gas to a face of said body portion, a portion only of said foot member being embedded in a rotor or stator leaving an orifice between an end of the rounded leading end portion and the surface of the rotor or stator for the flow of cooling gas to cool said foot member.

ADOLF MEYER.