

UNITED STATES PATENT OFFICE

2,398,523

FAN

James G. De Flon, Los Angeles, Calif., assignor
to The Fluor Corporation, Ltd., Los Angeles,
Calif., a corporation of California

Application February 22, 1943, Serial No. 476,738

1 Claim. (Cl. 230-120)

This invention relates to improvements in fan assemblies, for example of the type used in mechanical draft cooling towers, and has for its general object to obviate certain conditions causing loss of efficiency and air moving capacity of such fans, to the end that the displacement and distribution of air by the same will be materially improved. To illustrate a practical though typical embodiment, the invention will be described in a fan and ring assembly for mechanical draft cooling towers.

Cooling tower fan assemblies comprise a circular ring containing a centered fan operating in forced draft towers to discharge air into the lower portion of the water cooling chamber, and in induced draft towers to draw the air upwardly through the cooling chamber. Air displacement by the fan occurs predominately in a swirling course flowing in the direction of fan rotation and away from the fan. Investigations have revealed that the usual fan and ring assembly operates at less than its potential effective air moving capacity by reason of a condition of reverse air flow existing beyond the ends of the fan blades, or in the annular space between the fan ring and the path of the blade ends.

Rotation of the fan acts not only to displace the air in one direction through and beyond the body of the fan, but also to cause reverse flow of substantial amounts of air from the discharge side of the fan through the aforementioned space adjacent the fan ring. The net result is a loss of the desired maximum quantity of air flow through the cooling chamber, and a reduction of air distribution therein that otherwise would occur if the air flow through the fan ring were uni-directional to the full outer radial extent of its opening.

This usual state of reverse air flow within the fan ring is overcome by the invention through the use of individual baffles placed directly beyond the end portions of the blades at the discharge side of the fan, and serving to intercept and divert in the direction of the main air flow, the eddying streams tending to pass reversely beyond the blades. In its preferred form the baffle assembly comprises a series of circularly spaced vanes carried by the fan ring directly opposite the path of the end portions of the blades, and extending angularly therefrom in the direction of blade rotation. The normally reverse flowing air stream at the fan periphery is impinged against these vanes and is thereby deflected in the direction of the main air flow, thus increasing both the quantity and radial extent of the

fan displaced air. In other words, the effective working length of the blades is increased. These results are accomplished by the use of radially short deflector vanes, simple and economical to install, which permit the bulk of the air displaced by the inner portion of the fan to assume its normal course of flow.

All the features of the invention, as well as the details of a typical embodiment thereof, will be understood from the following description of the accompanying drawing, in which:

Fig. 1 is a diagrammatic cross-sectional view illustrating the fan and ring assembly applied to a forced draft tower;

Fig. 2 is a similar view illustrating an adaptation of the invention to an induced draft tower;

Fig. 3 is an enlarged view of the fan and ring assembly; and

Fig. 4 is a fragmentary plan on line 4-4 of Fig. 3.

Fig. 1 shows a conventional forced draft water cooling tower comprising a vertically extending chamber 10 enclosed by side walls 11 and 12, and into the upper interior of which water to be cooled is sprayed downwardly from header 13 over a suitable arrangement of decks or baffles 14, the cooled water finally being collected in basin 15. Air is discharged by the fan assembly 16 through the usual plenum chamber 17 into and upwardly through the cooling chamber 10 in intimate contact with water being filmed over the decks 14. Mist eliminators 18 at the top of the chamber remove entrained water from the air leaving the chamber.

In the induced draft type of tower shown in Fig. 2, the fan and ring assembly mounted in the top wall 20 of the cooling chamber 21, draws air inwardly through inlets 22 in the lower chamber side walls 23, and thence upwardly through the decks 24 in counter-flow to water being sprayed from header 25. The particular form of induced draft tower shown has slatted baffles 26 at the outside of the inlets 22 and spaced at 27 from the cooling chamber wall, the principal purposes of the baffles being to cause the air to flow downwardly and inwardly through the spaces 27 and baffles into the cooling chamber, and to baffle atmospheric winds sufficiently to prevent disturbance of desired conditions of air circulation within the tower.

The features with which the invention is primarily concerned, are more particularly illustrated in Figs. 3 and 4 showing a fan and ring assembly adaptable, as will be understood, for use in either type of tower shown in Figs. 1 and

2. Air flow through the cooling chamber is produced by a fan 28 of suitable construction and design, shown typically as comprising a hub 29 rotated by the motor driven shaft 30 and carrying a pair of blades 31 mounted on arms 32. The fan rotates within a ring 33, the inlet side of which preferably is shaped to have a widely flaring mouth 34 giving the ring Venturi characteristics facilitating and streamlining the passage of air into and through the ring. The blade ends are spaced at 35 from the fan ring a distance subject to some variation in fan and ring assemblies of different sizes. In a typical instance the fan diameter may be 144 inches and the internal diameter of the ring about 146½ inches.

The normal tendency of the fan is to discharge the air toward the right, as viewed in Fig. 3, in a swirling and advancing path of flow. Adjacent the surface of the fan ring, the air assumes not only a circular and advancing swirl, but also a reverse direction of flow in eddying backward between the fan ring and the path of the blade ends. The result is a corresponding loss in the effective air displacement and efficiency of the fan, and a reduction of the air distribution at the discharge side of the fan. My primary object is to substantially eliminate such by-passing of the air beyond the fan periphery, and in so doing to increase both the quantity and spread of the air stream being moved by the fan.

This object is achieved by providing within the fan ring directly opposite the end portions of the blades 31, a circular series of vanes 37. The number of such vanes is variable, although as typical, 14 may be used in a fan ring of 146½ inches diameter. Referring to Fig. 4, the vanes preferably are arranged to extend angularly away from the plane of fan rotation in the direction that the fan rotates and in substantial correspondence with the direction or course of air flow from the blades. Satisfactory results have been had with the vanes 37 placed at an angle of about 30° with line 39 paralleling the plane of fan rotation. As further illustrative, the radial extent of the vanes toward the fan axis may be around 5 inches, with a space of about 1 inch left at 40 between the inner ends of the vanes and the edges of the fan blades. It will be understood that the vanes may be positioned in any suitable manner, as by welding their inner edges to the fan ring.

The vanes 37 are placed sufficiently close to the fan to intercept and divert that portion of the

air at the blade terminals normally tending, as previously explained with reference to Fig. 5, to reverse its flow through space 35 toward the inlet side of the fan. To avoid undesirably abrupt diversion and deflection of the air, the vanes are extended at an angle generally in the direction of the swirling and advancing path taken by the air. By thus eliminating the by passing of air within the fan ring, more efficient water cooling occurs within the tower chamber due both to the increased quantity of air circulation and the greater distribution resulting from the air flow within the fan ring being extended to its full area.

15 Increased efficiency also has resulted from the use of differential diameter hub plates on the fan 28. As shown in Fig. 3, the longitudinal axes of the blades 31 are offset from the axes of the arms 32. Accordingly, the corners 31a of the blades lie on a circle of smaller diameter than the further offset corners 31b of the blades. The hub portion of the fan carries a pair of circular plates 41 and 42, the former having a smaller radius corresponding to, or being slightly greater than the radial distance of the blade corners 31a from the axis of shaft 30, while the larger radius of plate 42 corresponds substantially to, or is slightly greater than the radial distance of blade corner 31b from the projected axis of shaft 30. Plates 30 41 and 42 prevent flow of air through the central portion of the fan at the inside of the blade ends, and thus avoid the loss of efficiency and air displacement that otherwise would result from the churning action of the blade arms 32 on the air, 35 and any reverse air flow at the center of the chamber.

I claim:

In a stationary fan installation, the combination comprising a multiple blade fan, a ring surrounding and spaced from the ends of the fan blades, said ring having at the inlet side of the fan a widely flared mouth, circularly spaced vanes positioned entirely at the discharge side of the fan directly beyond the end portions of the blades 45 and extending radially inward short distances from the ring so that the vanes are impinged only by the air displaced at the tip portions of the fan blades, said vanes substantially preventing reverse flow of air under the influence of pressure differential between the inlet and outlet of the said ring.

JAMES G. DE FLON.