May 27, 1958 J. E. McDONALD 2,836,348

CENTRIFUGAL FAN WHEELS

Filed Nov. 2, 1954

Fig. 1.

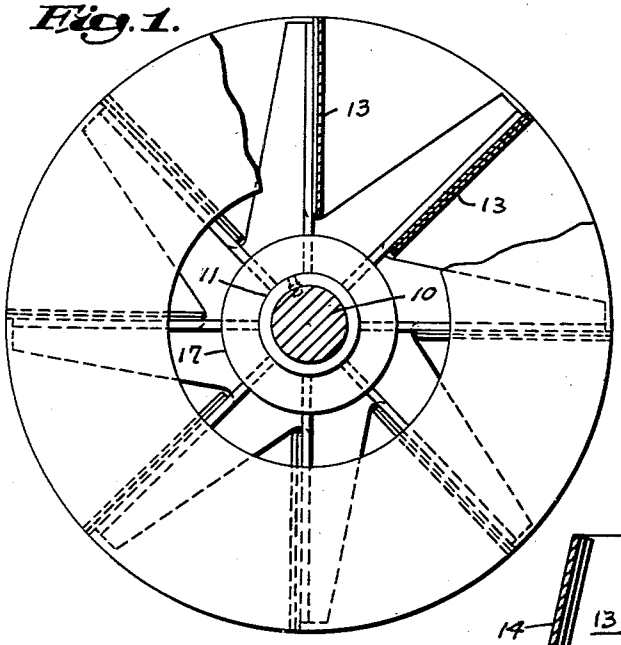


Fig. 2.

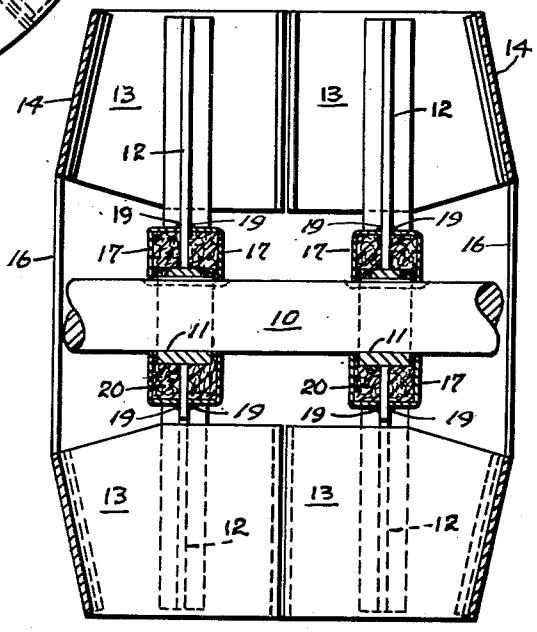
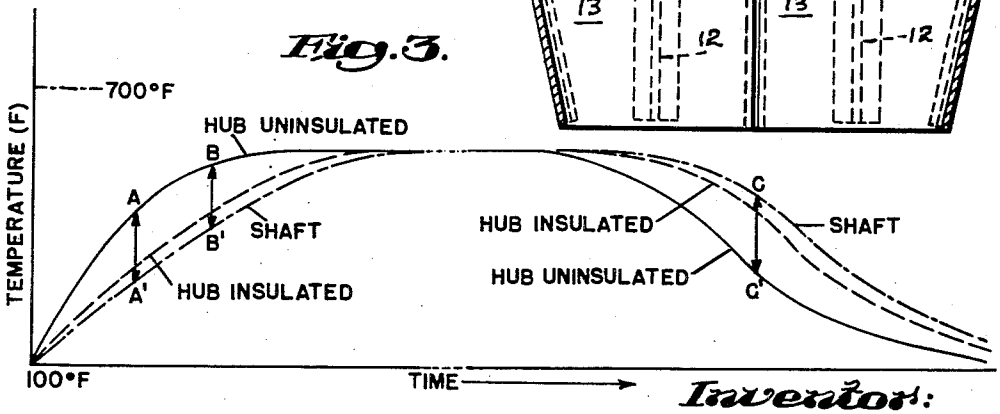


Fig. 3.



Inventor:
John E. McDonald,
by Robert T. Palmer Attorney

United States Patent Office

2,836,348

Patented May 27, 1958

2,836,348

CENTRIFUGAL FAN WHEELS

John E. McDonald, Newton, Mass., assignor to Westinghouse Electric Corporation, East Pittsburgh, Pa., a corporation of Pennsylvania

Application November 2, 1954, Serial No. 466,397

1 Claim. (Cl. 230—134)

This invention relates to fans designed for handling heated gases.

The hubs which support the blades of centrifugal fans usually have considerably less masses than their rotary shafts, and when such a fan is used to handle heated gases, its hub will increase in temperature faster than its shaft does shortly after the fan starts to handle the heated gas, and may become loose on the shaft. This condition is well known in the fan industry, and the attempted solution has been to shrink the hubs on the shafts. Occasionally, the fan wheel of such a fan will tear loose from its shaft, and will destroy itself and the fan, before the fan can be shut down. Heretofore, the reason for this has been explained as a fault in material or manufacture. However, I have determined that some of such failures have been caused by the increased shrinkages of previously shrunk hubs during temperature decreases. As a load temperature decreases, a hub having a smaller mass than its shaft has will cool off and shrink faster than the shaft does, causing such an increase in stress that the hub may crack, following which the fan wheel rotating at high speed may break away from the shaft.

I have found that by placing a can-like casing filled with a heat insulating material around such a hub, its expansion and contraction rates can be made to closely follow those of its associated shaft so that the hub will not loosen on temperature increases, and will not shrink critically on its shaft during temperature decreases.

An object of this invention is to provide a fan which can safely be used to handle heated gases having wide ranges of temperatures.

This invention will now be described with reference to the annexed drawings, of which:

Fig. 1 is an end elevation of a centrifugal fan wheel embodying this invention;

Fig. 2 is a sectional view along the line 2—2 of Fig. 1, and

Fig. 3 is a chart of curves showing the rates of temperature increase and decrease under a heated gas load, of the fan hubs and shaft of a fan similar to that of Figs. 1 and 2, with and without this invention.

The illustrated fan wheel is of the double inlet, induced draft type such as is shown in the U. S. Patent No. 2,653,755 of Ernest Kruhmin, and has a rotary shaft 10 on which a pair of hubs 11 are keyed and shrunk. The usual blade supporting bars 12 are welded to the hubs, and support the blades 13. The wheel has the usual side plates 14. The construction described so far in connection with Figs. 1 and 2 is conventional. In operation, gas is drawn in through axial openings 16 in the side plates 14, and is discharged from the blades in generally radial directions into an involute casing which is not illustrated.

Extending around the hubs 11 on opposite sides of the bars 12 are the shells 17 of sheet metal which are essentially pan shaped except that they have central openings 18 slightly larger than the shaft 10 for clearing the latter. The inner ends of the shells 17 are spot welded

at 19 to the bars 12. The spaces between the hubs and the interior surfaces of the shells are filled with a heat insulating material 20 such as TW–F glass wool manufactured by the Corning Glass Company.

In operation, the glass wool 20 so insulates the hubs 11 that their rates of temperature increase and decrease closely approximate those of the shaft 10.

In Fig. 3, the solid line curve shows the rate of temperature increase and decrease of the hubs without the insulation; the dash-dot curve shows the rate of temperature increase and decrease of the shaft, and the dashed line curve shows the rate of temperature increase and decrease of the hubs using the insulation.

With a 120" diameter wheel having a shaft with a central diameter of 12" and a length of 218", with each hub having an outer diameter of 17½" and an axial length of 9½", the mass of each hub is but a small fraction of that of the shaft with the result that when the wheel starts to handle a heated gas, the temperature of each uninsulated hub increases at a faster rate than that of the shaft. The hubs will expand faster than the shaft does, and will become loose on the shaft between the points A and B on the uninsulated hub curve.

It is usual to shrink such a hub on such a shaft about .004". In the central portion of Fig. 3, the three curves merge since in that region sufficient time has elapsed for the shaft to reach the same temperature as the hubs. Thus, at the start of operation, and after a period of operation, the hubs are shrunk .004" on the shaft.

The uninsulated hubs cool off much faster than the shaft does, causing the shrinkage of the hubs on the shaft to increase from .004" to .014" at the point C on the uninsulated hub curve, causing a dangerous increase in stress which may result in the hubs cracking and the fan being destroyed before it can be shut down.

Fig. 3 shows that the insulated hub curve closely follows the shaft curve. The insulation delays the rise in temperature of the hubs so that their temperature cannot become sufficiently greater than that of the shaft for the hubs to become loose, and delays the decay in temperature of the hubs so that their temperature cannot become sufficiently less than that of the shaft for the hubs to shrink critically.

While one embodiment of this invention has been described for the purpose of illustration, it should be understood that the invention is not limited to the exact apparatus and arrangement of apparatus illustrated, since modifications thereof may be suggested by those skilled in the art, without departure from the essence of the invention.

Whati s claimed, is:

In a centrifugal fan having a rotary shaft, a hub secured to said shaft, a blade supporting member attached to said hub, and blades attached to said supporting member, the combination of a pair of sheet metal casings around said hub on opposite sides of said supporting member, said casings having inner ends attached to opposite sides of said member, having cylindrical portions extending from said member to beyond the ends of said hub, and having outer end portions extending inwardly towards said shaft, said end portions having clearance openings around said shaft, and heat insulating material within said casings around said hub.

References Cited in the file of this patent

UNITED STATES PATENTS

1,090,495	Otis	Mar. 17, 1914
2,428,728	Waston	Oct. 7, 1947
2,649,278	Stalker	Aug. 18, 1953

FOREIGN PATENTS

138,839	Australia	Sept. 26, 1950