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DEPARTMENT OF TRANSPORTATION
NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C. 20591

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MAR 1 1 1968

IN REPLY
REFER TO: NC-1-NA-68-96

Honorable William F. McKee
Administrator
Federal Aviation Administration
Department of Transportation
Washington, D. C. 20590

Dear General McKee:

On February 12, 1968, a Cessna P-206A, N4653F, crashed shortly after takeoff at the Municipal Airport, Fort Madison, Iowa. The pilot and one of the three passengers were seriously injured.

Our investigation of this accident revealed that a fatigue fracture had occurred in the propeller hub, McCauley Model No. D3A32C77, S/N 661180. The fracture in the hub had permitted one of the propeller blades to separate from the hub during take-off.

Examination of the failed hub in our metallurgical laboratory showed that a fatigue crack had originated in one of the thread roots of the internal blade retaining threads. Fracture surface markings indicated that the fatigue crack propagated rather slowly until it was approximately 3/4 inch long and 3/8 inch deep. After the crack reached this size its propagation rate apparently increased rapidly, particularly after it broke through the outside surface, and the hub failed completely when the crack was about three inches long.

Although our laboratory examination of the failed hub has not been completed, we have found evidence of localized high contact pressure and fretting on the thread flanks in the vicinity of the fatigue fracture. This could be an indication of improper mating between the threads of the blade retention nut and the threads in the hub, possibly due to imperfections in the machining of the threads. Such improper mating of the threads probably would result in a detrimental distribution of stresses in the hub.

This is the first fatigue failure of a McCauley hub for a three blade propeller that has come to our attention, but there have been numerous fatigue cracks and fractures in McCauley hubs for two blade propellers (Models 2D3$\frac{1}{4}$C, D2AF3$\frac{1}{4}$C, D2A3$\frac{1}{4}$C, 2AF34C and 2A34C). Fatigue crack origins in these blades have been found in the blade retaining threads, at stud holes, and at the latch plate slot. The fact that fatigue cracks have developed at so many different locations in the hubs appears to indicate that the design is marginal. Our examination of a few of these hubs indicate that their resistance to fatigue failure could be improved by the use of rolled rather than cut threads and by rounding the edges of the latch plate slot. These edges have been very sharp in the hubs that we have examined. There is a possibility that shot peening might improve existing cut threads but this operation would have to be carefully controlled to assure that an adequate peening effect is achieved at the bottom of the thread roots.

In view of the serious accidents that have been caused by fatigue failures in McCauley propeller hubs and the possibility that such failures might cause other accidents, consideration of the following proposals is recommended:

1. That an immediate inspection program for fatigue cracks and evidence of localized fretting in McCauley hubs for two and three blade propellers be initiated. This inspection should be adequate to detect small fatigue cracks in the roots of the blade retaining threads of both types of hubs and at the latch plate slot and stud holes of the two blade hubs. The examination for fretting should be directed specifically to the inboard flanks of the blade retaining threads and the mating flanks of the blade retention nut.

2. That a radius requirement be specified for the edges of the latch plate slots in both existing hubs and those manufactured in the future.

3. That the feasibility of shot peening the blade retaining threads in existing hubs and forming these threads by rolling in hubs manufactured in the future be investigated.

4. That a review of the design of the hubs be conducted to determine whether their fatigue strength is adequate in the areas where cracks have originated.

Mr. Robert Berman of your Eastern Region and Mr. Walter Voisard of McCauley Propellers are aware of this problem and both recently visited our laboratory to participate in the examination of two of the failed hubs. Our staff will be available for any further assistance it might be able to give you in this matter.

Sincerely yours,

[illegible]

Joseph J. O'Connell, Jr.
Chairman